SCIENCE

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*THE PROBLEMS OF ASTRONOMY.**

ASSEMBLED, as we are, to dedicate a new institution to the promotion of our knowledge of the heavens, it appeared to me that an appropriate and interesting subject might be the present and future problems of astronomy. Yet it seemed, on further reflection, that, apart from the difficulty of making an adequate statement of these problems on such an occasion as the present, such a wording of the theme would not fully express the idea which I wish to convey. The so-called problems of astronomy are not separate and independent, but are rather the parts of one great problem, that of increasing our knowledge of the universe in its widest extent. Nor is it easy to contemplate the edifice of astronomical science as it now stands, without thinking of the past as well as of the present and future. The fact is that our knowledge of the universe has been in the nature of a slow and gradual evolution, commencing at a very early period in human history, and destined to go forward without stop, as we hope, so long as civilization shall endure. The astronomer of every age has built on the foundations laid by his predecessors, and his work has always formed, and must ever form, the base on which his successors shall build. The astronomer of to-day may look

*An address given by Professor Simon Newcomb at the dedication of the Flower Observatory, University of Pennsylvania, May 12, 1897.

back upon Hipparchus and Ptolemy as the earliest ancestors of whom he has positive knowledge. He can trace his scientific descent from generation to generation, through the periods of Arabian and mediæval science, through Copernicus, Kepler, Newton, La Place and Herschel, down to the present time. The evolution of astronomical knowledge, generally slow and gradual, offering little to excite the attention of the public, has yet been marked by two cataclysms. One of these is seen in the grand conception of Copernicus that this earth on which we dwell is not a globe fixed in the center of the universe, but is simply one of a number of bodies, turning on their own axes and at the same time moving around the sun as a center. It has always seemed to me that the real significance of the heliocentric system lies in the greatness of this conception rather than in the fact of the discovery itself. There is no figure in astronomical history which may more appropriately claim the admiration of mankind through all time than that of Copernicus. Scarcely any great work was ever so exclusively the work of one man as was the heliocentric system the work of the retiring sage of Frauenburg. No more striking contrast between the views of scientific research entertained in his time and in ours can be seen than that seen in the fact that, instead of claiming credit for his great work, he deemed it rather necessary to apologize for it and, so far as possible, to attribute his ideas to the ancients.

A century and a half after Copernicus followed the second great step, that taken by Newton. This was nothing less than showing that the seemingly complicated and inexplicable motions of the heavenly bodies were only special cases of the same kind of motion, governed by the same forces, that we see around us whenever a stone is thrown by the hand or an apple falls to the ground. The actual motions of the heavens and the laws which govern them being known, man had the key with which he might commence to unlock the mysteries of the universe.

When Huyghens, in 1656, published his *Systema Saturnium*, where he first set forth the mystery of the rings of Saturn, which, for nearly half a century, had perplexed telescopic observers, he prefaced it with a remark that many, even among the learned, might condemn his course in devoting so much time and attention to matters far outside the Earth, when he might better be studying subjects of more concern to humanity. Notwithstanding that the inventor of the pendulum clock was, perhaps, the last astronomer against whom a neglect of things terrestrial could be charged, he thought it necessary to enter into an elaborate defense of his course in studying the heavens. Now, however, the more distant objects are in space—I might almost add the more distant events are in time—the more they excite the attention of the astronomer, if only he can hope to acquire positive knowledge about them. Not, however, because he is more interested in things distant than in things near, but because thus he may more completely embrace in the scope of his work the beginning and the end, the boundaries of all things, and thus, indirectly, more fully comprehend all that they include. From his standpoint

> "All are but parts of one stupendous whole,
> Whose body nature is and God the soul."

Others study nature and her plans as we see them developed on the surface of this little planet which we inhabit; the astronomer would fain learn the plan on which the whole universe is constructed. The magnificent conception of Copernicus is, for him, only an introduction to the yet more magnificent conception of infinite space containing a collection of bodies which we call

the visible universe. How far does this universe extend? What are the distances and arrangements of the stars? Does the universe constitute a system? If so, can we comprehend the plan on which this system is formed, of its beginning and of its end? Has it bounds outside of which nothing exists but the black and starless depths of infinity itself? Or are the stars we see simply such members of an infinite collection as happen to be the nearest our system? A few such questions as these we are perhaps beginning to answer; but hundreds, thousands, perhaps even millions of years may elapse without our reaching a complete solution. Yet the astronomer does not view them as Kantian antinomies, in the nature of things insoluble, but as questions to which he may hopefully look for at least a partial answer.

The problem of the distances of the stars is of peculiar interest in connection with the Copernican system. The greatest objection to this system, which must have been more clearly seen by astronomers themselves than by any others, was found in the absence of any apparent parallax of the stars. If the earth performed such an immeasurable circle around the sun as Copernicus maintained, then, as it passed from side to side of its orbit, the stars outside the solar system must appear to have a corresponding motion in the other direction, and thus to swing back and forth as the earth moved in one and the other direction. The fact that not the slightest swing of that sort could be seen was, from the time of Ptolemy, the basis on which the doctrine of the earth's immobility rested. The difficulty was simply ignored by Copernicus and his immediate successors. The idea that Nature would not squander space by allowing immeasurable stretches of it to go unused seems to have been one from which mediæval thinkers could not entirely break away. The consideration that there could be no need of any such economy, because the supply was infinite, might have been theoretically acknowledged, but was not practically felt. The fact is that magnificent as was the conception of Copernicus, it was dwarfed by the conception of stretches from star to star so vast that the whole orbit of the earth was only a point in comparison.

An indication of the extent to which the difficulty thus arising was felt is seen in the title of a book published by Horrebow, the Danish astronomer, some two centuries ago. This industrious observer, one of the first who used an instrument resembling our meridian transit of the present day, determined to see if he could find the parallax of the stars by observing the intervals at which a pair of stars in oppposite quarters of the heavens crossed his meridian at opposite seasons of the year. When, as he thought, he had won success he published his observations and conclusions under the title of '*Copernicus Triumphans.*' But alas! the keen criticism of his contemporaries showed that what he supposed to be a swing of the stars from season to season arose from a minute variation in the rate of his clock, due to the different temperatures to which it was exposed during the day and the night. The measurement of the distance even of the nearest stars evaded astronomical research, until Bessel and Struve arose in the early part of the present century.

On some aspects of the problem of the extent of the universe light is being thrown even now. Evidence is gradually accumulating which points to the probability that the successive orders of smaller and smaller stars, which our continually increasing telescopic power brings into view, are not situated at greater and greater distances, but that we actually see the boundary of our universe. This indication lends a peculiar interest to various questions growing out of the motions of the stars. Quite pos-

sibly the problem of these motions will be the great one of the future astronomer. Even now it suggests thoughts and questions of the most far-reaching character.

I have seldom felt a more delicious sense of repose than when crossing the ocean during the summer months I sought a place where I could lie alone on the deck, look up at the constellations, with *Lyra* near the zenith, and, while listening to the clank of the engine, try to calculate the hundreds of millions of years which would be required by our ship to reach the star α Lyræ if she could continue her course in that direction without ever stopping. It is a striking example of how easily we may fail to realize our knowledge when I say that I have thought many a time how deliciously one might pass those hundred millions of years in a journey to the star α Lyræ, without its occurring to me that we are actually making that very journey at a speed compared with which the motion of a steamship is slow indeed. Through every year, every hour, every minute, of human history from the first appearance of man on the earth, from the era of the builders of the Pyramids, through the times of Cæsar and Hannibal, through the period of every event that history records, not merely our earth, but the sun and the whole solar system with it, have been speeding their way toward the star of which I speak on a journey of which we know neither the beginning nor the end. During every clock-beat through which humanity has existed it has moved on this journey by an amount which we cannot specify more exactly than to say that it is probably between five and nine miles per second. We are at this moment thousands of miles nearer to α Lyræ than we were a few minutes ago when I began this discourse, and through every future moment, for untold thousands of years to come, the earth and all there is on it will be nearer to α Lyræ, or nearer to the place where that star now is, by hundreds of miles for every minute of time come and gone. When shall we get there? Probably in less than a million years, perhaps in half a million. We cannot tell exactly, but get there we must if the laws of nature and the laws of motion continue as they are. To attain to the stars was the seemingly vain wish of the philosopher, but the whole human race is, in a certain sense, realizing this wish as rapidly as a speed of six or eight miles a second can bring it about.

I have called attention to this motion because it may, in the not distant future, afford the means of approximating to a solution of the problem already mentioned, that of the extent of the universe. Notwithstanding the success of astronomers during the present century in measuring the parallax of a number of stars, the most recent investigations show that there are very few, perhaps hardly more than a score of stars of which the parallax, and therefore the distance, has been determined with any approach to certainty. Many parallaxes, determined by observers about the middle of the century, have had to disappear before the powerful tests applied by measures with the heliometer; others have been greatly reduced, and the distances of the stars increased in proportion. So far as measurement goes, we can only say of the distances of all the stars, except the few whose parallaxes have been determined, that they are immeasurable. The radius of the earth's orbit, a line more than ninety millions of miles in length, not only vanishes from sight before we reach the distance of the great mass of stars, but becomes such a mere point that, when magnified by the powerful instruments of modern times, the most delicate appliances fail to make it measurable. Here the solar motion comes to our help. This motion, by which, as I have said, we are carried unceasingly

through space, is made evident by a motion of most of the stars in the opposite direction, just as, passing through a country on a railway, we see the houses on the right and on the left being left behind us. It is clear enough that the apparent motion will be more rapid the nearer the object. We may, therefore, form some idea of the distance of the stars when we know the amount of the motion. It is found that, in the great mass of stars of the sixth magnitude, the smallest visible to the naked eye, the motion is about three seconds per century. As a measure thus stated does not convey an accurate conception of magnitude to one not practiced in the subject, I would say that, in the heavens, to the ordinary eye, a pair of stars will appear single unless they are separated by a distance of 150 or 200 seconds. Let us then imagine ourselves looking at a star of the sixth magnitude, which is at rest while we are carried past it with the motion of six or eight miles per second which I have described. Mark its position in the heavens as we see it to-day; then let its position again be marked 5,000 years hence. A good eye will just be able to perceive that there are two stars marked instead of one. The two would be so close together that no distinct space between them could be perceived by unaided vision. It is due to the magnifying power of the telescope, enlarging such small apparent distances, that the motion has been determined in so small a period as the 150 years during which accurate observations of the stars have been made.

The motion just described has been fairly well determined for what astronomically speaking are the brighter stars, that is to say those visible to the naked eye. But how is it with the millions of faint telescopic stars, especially those which form the cloud masses of the Milky Way? The distance of these stars is undoubtedly greater, and the apparent motion is, therefore, smaller. Accurate observations upon such stars have been commenced only recently, so that we have not yet had time to determine the amount of the motion. But the indication seems to be that it will prove quite a measurable quantity, and that before the twentieth century has elapsed it will be determined for very much smaller stars than those which have heretofore been studied. A photographic chart of the whole heavens is now being constructed by an association of observatories in some of the leading countries of the world. I cannot say all the leading countries, because then we should have to exclude our own, which, unhappily, has taken no part in this work. At the end of the twentieth century we may expect that the work will be repeated. Then, by comparing the charts, we shall see the effect of the solar motion and, perhaps, get new light upon the problem in question.

Closely connected with the problem of the extent of the universe is another which appears, for us, to be insoluble because it brings us face to face with infinity itself. We are familiar enough with eternity, or, let us say, the millions or hundreds of millions of years which geologists tell us must have passed while the crust of the earth was assuming its present form, our mountains being built, our rocks consolidated, and successive orders of animals coming and going. Hundreds of millions of years is, indeed, a long time, and yet, when we contemplate the changes supposed to have taken place during that time, we do not look out on eternity itself, which is veiled from our sight, as it were, by the unending succession of changes that mark the progress of time. But in the motions of the stars we are brought face to face with eternity and infinity, covered by no veil whatever. It would be bold to speak dogmatically on a subject where the springs of

being are so far hidden from mortal eyes as in the depths of the universe. But, without declaring its positive certainty, it must be said that the conclusion seems unavoidable that a number of stars are moving with a speed such that the attraction of all the bodies of the universe could never stop them. One such case is that of Arcturus, the bright reddish star familiar to mankind since the days of Job, and visible near the zenith on the clear evenings of May and June. Yet another case is that of a star known in astronomical nomenclature as 1830 Groombridge, which exceeds all others in its angular proper motion, as seen from the earth. We should naturally suppose that it seems to move so fast because it is near us. But the best measurements of its parallax seem to show that it can scarcely be less than two million times the distance of the earth from the sun, while it may be much greater. Accepting this result, its velocity cannot be much less than 200 miles per second, and may be much more. With this speed it would make the circuit of our globe in two minutes, and had it gone round and round in our latitudes we should have seen it fly past us a number of times since I commenced this discourse. It would make the journey from the earth to the sun in five days. If it is now near the center of our system it would probably reach its confines in a million of years. So far as our knowledge of nature goes, there is no force in nature which would ever have set it in motion, and no force which can ever stop it. What, then, was the history of this star, and if there are planets circulating around, what the experience of beings who may have lived on those planets during the ages which geologists and naturalists assure us our earth has existed? Did they see, at night, only a black and starless heaven? Was there a time when, in that heaven, a small faint patch of light began gradually to appear? Did that patch of light grow larger and larger as million after million of years elapsed? Did it at last fill the heavens and break up into constellations as we now see them? As millions more of years elapse will the constellations gather together in the opposite quarter, and gradually diminish to a patch of light as the star pursues its irresistible course of 200 miles per second through the wilderness of space, leaving our universe farther and farther behind it, until it is lost in the distance? If the conceptions of modern science are to be considered as good for all time, a point on which I confess to a large measure of scepticism, then these questions must be answered in the affirmative.

Intimately associated with these problems is that of the duration of the universe in time. The modern discovery of the conservation of energy has raised the question of the period during which our sun has existed and may continue in the future to give us light and heat. Modern science tells us that the quantity of light and heat which can be stored in it is necessarily limited, and that, when radiated as the sun radiates, the supply must in time be exhausted. A very simple calculation shows that were there no source of supply the sun would be cooled off in three or four thousand years. Whence, then, comes the supply? During the past thirty years the source has been sought for in a hypothetical contraction of the sun itself. True, this contraction is too small to be observed; several thousand years must elapse before it can be measurable with our instruments. Granting that this is and always has been the sole source of supply, a simple calculation shows that the sun could scarcely have been giving its present amount of heat for more than twenty or thirty millions of years. Before that time the earth and the sun must have formed one body, a great nebula, by the condensation of which both are supposed to have been formed. But

the geologists tell us that the age of the earth is to be reckoned by hundreds of millions of years. Thus arises a question to which physical science has not been able to give an answer.

The problems of which I have so far spoken are those of what may be called the older astronomy. If I apply this title it is because that branch of the science to which the spectroscope has given birth is often called the new astronomy. It is commonly to be expected that a new and vigorous form of scientific research will supersede that which is hoary with antiquity. But I am not willing to admit that such is the case with the old astronomy, if old we may call it. It is more pregnant with future discoveries to-day than it ever has been, and it is more disposed to welcome the spectroscope as a useful hand-maid, which may help it on to new fields, than it is to give way to it. How useful it may thus become has been recently shown by a Dutch astronomer, who finds that the stars having one type of spectrum belong mostly to the Milky Way, and are farther from us than the others.

In the field of the newer astronomy perhaps the most interesting work is that associated with comets. It must be confessed, however, that the spectroscope has rather increased than diminished the mystery which, in some respects, surrounds the constitution of these bodies. The older astronomy has satisfactorily accounted for their appearance, and we might also say for their origin and their end, so far as questions of origin can come into the domain of science. It is now known that comets are not wanderers through the celestial spaces from star to star, but must always have belonged to our system. But their orbits are so very elongated that thousands, or even hundreds of thousands, of years are required for a revolution. Sometimes, however, a comet passing near to Jupiter is so fascinated by that planet that, in its vain attempts to follow it, it loses so much of its primitive velocity as to circulate around the sun in a period of a few years, and thus to become, apparently, a new member of our system. If the orbit of such a comet, or in fact of any comet, chances to intersect that of the earth, the latter in passing the point of intersection encounters minute particles which causes a meteoric shower. The great showers of November, which occur three times in a century and were well known in the years 1866–67, may be expected to reappear about 1900, after the passage of a comet which, since 1866, has been visiting the confines of our system, and is expected to return about two years hence.

But all this does not tell us much about the nature and make-up of a comet. Does it consist of nothing but isolated particles, or is there a solid nucleus, the attraction of which tends to keep the mass together? No one yet knows. The spectroscope, if we interpret its indications in the usual way, tells us that a comet is simply a mass of hydro-carbon vapor, shining by its own light. But there must be something wrong in this interpretation. That the light is reflected sunlight seems to follow necessarily from the increased brilliancy of the comet as it approaches the sun and its disappearance as it passes away.

Great attention has recently been bestowed upon the physical constitution of the planets and the changes which the surfaces of those bodies may undergo. In this department of research we must feel gratified by the energy of our countrymen who have entered upon it. Should I seek to even mention all the results thus made known, I might be stepping on dangerous ground, as many questions are still unsettled. While every astronomer has entertained the highest admiration for the energy and enthusiasm shown by Mr. Percival

Lowell in founding an observatory in regions where the planets can be studied under the most favorable conditions, they cannot lose sight of the fact that the ablest and most experienced observers are liable to error when they attempt to delineate the features of a body 50 or 100 million miles away through such a disturbing medium as our atmosphere. Even on such a subject as the canals of Mars doubts may still well be felt. That certain markings to which Schiaperelli gave the name of canals exist, few will question. But it may be questioned whether these markings are the fine sharp uniform lines found on Schiaparelli's map and delineated in Mr. Lowell's beautiful book. It is certainly curious that Barnard at Mount Hamilton, with the most powerful instrument and under the most favorable circumstances, does not see these markings as canals.

I can only mention among the problems of the spectroscope the elegant and remarkable solution of the mystery surrounding the rings of Saturn, which has been effected by Keeler at Allegheny. That these rings could not be solid has long been a conclusion of the laws of mechanics, but Keeler was the first to show that they must consist of separate particles, because the inner portions revolve more rapidly than the outer. The question of the atmosphere of Mars has also received an important advance by the work of Campbell at Mount Hamilton. Although it is not proved that Mars has no atmosphere, for the existence of some atmosphere can scarcely be doubted, yet the Mt. Hamilton astronomer seems to have shown, with great conclusiveness, that it is so rare as not to produce any sensible absorption of the solar rays.

I have left an important subject for the close. It belongs entirely to the older astronomy, and it is one with which I am glad to say this observatory is expected to especially concern itself. I refer to the question of the variation of latitudes, that singular phenomenon scarcely suspected ten years ago, but brought out by observations in Germany during the past eight years, and reduced to law with such brilliant success by our own Chandler. The north pole is not a fixed point on the earth's surface, but moves around in rather an irregular way. True, the motion is small; a circle of sixty feet in diameter will include the pole in its widest range. This is a very small matter so far as the interests of daily life are concerned. But it is very important to the astronomer. It is not simply a motion of the pole of the earth, but a wabbling of the solid earth itself. No one knows what conclusions of importance to our race may yet follow from a study of the stupendous forces necessary to produce even this slight motion.

The director of this new observatory has already distinguished himself in the delicate and difficult work of investigating this motion, and I am glad to know that he is continuing the work here with one of the finest instruments ever used in it, a splendid product of American mechanical genius. I can assure you that astronomers the world over will look with the greatest interest for Professor Doolittle's success in the arduous task he has undertaken.

There is one question connected with these studies of the universe on which I have not touched, and which is, nevertheless, of transcendent interest. What sort of life, spiritual and intellectual, exists in distant worlds? We cannot for a moment suppose that our own little planet is the only one throughout the whole universe on which may be found the fruits of civilization, warm firesides, friendship, the desire to penetrate the mysteries of creation. And yet, this question is not to-day a problem of astronomy, nor can we see any prospect that it ever will be, for the simple reason that science affords us no hope of

an answer to any question that we may send through the fathomless abyss. When the spectroscope was in its infancy it was suggested that possibly some difference might be found in the rays reflected from living matter, especially from vegetation, that might enable us to distinguish them from rays reflected by matter not endowed with life. But this hope has not been realized, nor does it seem possible to realize it. The astronomer cannot afford to waste his energies on hopeless speculation about matters of which he cannot learn anything, and he therefore leaves this question of the plurality of worlds to others who are as competent to discuss it as he is. All he can tell the world is:

> He who through vast immensity can pierce,
> See worlds on worlds compose one universe;
> Observe how system into system runs,
> What other planets circle other suns,
> What varied being peoples every star,
> May tell why Heaven has made us as we are.

SIMON NEWCOMB.

WASHINGTON, D. C.

THE RECENT VISIT OF SIR ARCHIBALD GEIKIE.

AMERICAN geology has been greatly benefited and stimulated by visits from distinguished European scientists, since the early part of the present century. All will recall at once Bakewell's observations on the recession of Niagara; Lyell's two visits, with the four volumes of 'Travels in America' that resulted, and that helped so much to establish a good correlation between many of our formations and those of Europe; von Richthofen's four years on the Pacific coast, and Credner's four years in the East; Posepny's travels in our mining districts; vom Rath's visits to mineral localities, and Geikie's excursions across the lava fields of the Snake River country. After an interval of eighteen years, the honor of again entertaining the distinguished Director of the British Geological Survey has fallen to American geologists, and has proved to be an occasion of exceptional interest and importance.

Some months ago Sir Archibald was invited by the authorities at the Johns Hopkins University to come to Baltimore and open the course of lectures in geology, made possible by a foundation established by Mrs. George Huntington Williams, in memory of her husband, the late, greatly lamented professor at Johns Hopkins. The purpose of the foundation is to support an annual course of lectures in geology which are to be given alternately by European and American geologists of distinction. No more fitting choice for the first series could have been made than that of Sir Archibald Geikie, to whose cosmopolitan sympathies, as shown in his 'textbook,' geologists everywhere owe so great a debt.

Sir Archibald reached New York April 17th, and on April 19th was given a reception by the New York Academy of Sciences, as described in an earlier page of SCIENCE (p. 702). Geologists from many institutions outside of New York united with the members of the Academy to make the welcome a cordial and significant one.

On Wednesday, April 21st, Sir Archibald began, at the Johns Hopkins University, the course of lectures which was the main object of his visit. The subject chosen was 'The Founders of Geology,' and in his treatment of the theme the lecturer sketched the rise of geological conceptions among the ancient cosmogonists, tracing their gradual though slow evolution through the middle ages, and their vigorous development at the opening of the present century. Exhaustive studies have been made by Sir Archibald upon these special subjects, and much new light has been thrown by them upon the true relations of modern systems of thought to the work of the pioneers in this field a hundred years and less ago. The lectures will ultimately be published, and space is

not available at this time to review them, but they cannot fail to be of great significance to all thoughtful students of the problems before us to-day.

Previously to the delivery of the lectures invitations had been sent by the Johns Hopkins University to geologists throughout the country, asking them to be present and to share in the excursions that were incident to the occasion. In response, the fifty or more whose names appear below accepted. While the lectures were being delivered short excursions were conducted almost daily to places of geological interest near Baltimore, on one of which Sir Archibald and his companions were the guests of the Secretary of the Navy at the Naval Academy, Annapolis, and upon one of the United States government vessels on a trip to view the Cretaceous and Tertiary formations along the Severn River.

A longer excursion was made at the close of the lecture so as to illustrate the geology of the State of Maryland from the later formations of the Coastal Plain, across the Archean axis of the Blue Ridge, and the Paleozoics as far as the upper Coal Measures in the St. George's field. Through the vigorous and untiring efforts of Professor W. B. Clark, who is also State Geologist of Maryland, the interest of the Governor of the State and of the principal railway and mining officials had been secured, so that free transportation was given on the Baltimore and Ohio, the Cumberland and Potomac,and the Western Maryland Railways, as well as on one of the State official steamboats. On Wednesday, April 28th, the State vessel 'Governor McLane' carried a party of forty down Chesapeake Bay to view the Cretaceous and Tertiary strata in the bluffs along the shore. That evening two sleepers were boarded and reinforced by about ten additional guests from Washington; the party was taken to Cumberland, Md., from which starting point the members visited the St. George's coal field, as guests of President Lord, of the Consolidation Coal Company. Thursday evening Governor Lowndes, of Maryland, entertained the party at a reception in Cumberland. Friday was passed among the Cambrian, Silurian, Devonian and Triassic exposures along the Potomac River, and Saturday the President of the Western Maryland Railroad guided the visitors over the Blue Ridge mountains, where the Cambrian quartzite and pre-Cambrian volcanics are so well exposed. The trips closed with a visit to the battle-field at Gettysburg. It has left a lively feeling of appreciation in the minds of all the participants toward their generous entertainers, and especially toward Professor Clark and his associates at Johns Hopkins, whose efforts both before and during the trip were unstintedly given. The following list of participants in the excursions will indicate the very general desire on the part of American geologists to do honor to the distinguished guest:

F. D. Adams, McGill College, Montreal; Cleveland Abbe, Jr., of Washington; R. M. Bagg, Johns Hopkins University; W. S. Bayley, Colby University; F. Bascom, Bryn Mawr College; George F. Becker, U. S. Geological Survey; L. A. Bauer, University of Cincinnati; J. M. Clarke, Assistant State Geologist of New York; Samuel Calvin, State Geologist of Iowa; W. B. Clark, State Geologist of Maryland; N. H. Darton, U. S. Geological Survey; J. S. Diller, U. S. Geological Survey; C. W. Dorsey, U. S. Department of Agriculture; S. F. Emmons, U. S. Geological Survey; O. L. Fassig, U. S. Weather Bureau; Sir Archibald Geikie; D. C. Gilman, Johns Hopkins University: L. C. Glenn, North Carolina; R. T. Hill, U. S. Geological Survey; A. B. Hoen, of Baltimore; J. A. Holmes, State Geologist of North Carolina; C. W. Hayes, U. S. Geological Survey; J.

C. Hartzell, South Carolina; T. C. Hopkins, Pennsylvania State College; E. V. d'Invilliers, State Geologist of Pennsylvania; Lyman C. Josephs, of Newport, R. I.; Arthur Keith, U. S. Geological Survey; J. F. Kemp, Columbia University; E. P. King, Portland, Maine; Elizabeth Kirkbride, Bryn Mawr College; E. C. E. Lord, U. S. Geological Survey; F. J. H. Merrill, State Museum, Albany; W J McGee, U. S. Bureau of Ethnology; S. W. McCalley, Assistant State Geologist of Georgia; E. B. Matthews, Johns Hopkins University; J. A. Mitchell, Mt. St. Mary's College, Maryland; F. H. Newell, U. S. Geological Survey; W. H. Niles, Massachusetts Institute of Technology; Edw. Orton, State Geologist of Ohio; C. C. O'Harra, Carthage College, Illinois; Major J. W. Powell, Bureau of American Ethnology; L. V. Pirsson, Yale University; F. B. Peck, Lafayette College; Heinrich Ries, Columbia University; Harry Fielding Ried, Johns Hopkins University; R. D. Salisbury, University of Chicago; A. C. Spencer, U. S. Geological Survey; T. W. Stanton, U. S. Geological Survey; G. O. Smith, U. S. Geological Survey; G. W. Stose, U. S. Geological Survey; J. Stanley-Brown, of Washington; G. B. Shattuck, Johns Hopkins University; Chas. R. Van Hise, University of Wisconsin; C. D. Walcott, U. S. Geological Survey; Lester F. Ward, U. S. Geological Survey; T. G. White, Columbia University; I. C. White, Morgantown, W. Va.; H. S. Williams, Yale University; Bailey Willis, U. S. Geological Survey.

As the party was about to disband the following letter was drawn up:

TO THE BOARD OF COMMISSIONERS OF THE MARYLAND GEOLOGICAL SURVEY AND THE STATE GEOLOGIST:

Gentlemen: We have spent the last four days in a most interesting inspection of Maryland's geology, under conditions which your hospitable forethought has made peculiarly favorable. Our appreciation of the provisions made for the comfort of the party is keen, and our enjoyment of the excursion has been all that you could have wished it. In twice traversing the State of Maryland, opportunity has been afforded us of observing its mineral wealth, and in coming in contact with a wide range of phenomena illustrative of many of the aspects of geology. The field is rich, and it affords opportunities for inquiries which may add honor and wealth to the Commonwealth, contributing at the same time to the sum of human knowledge. The exploitation of these opportunities will be safe under your guidance, and we wish you a speedy success.

The paper was signed by Sir Archibald Geikie and the entire company of geologists.

At the close of the Baltimore visit, Sir Archibald went, on May 3d, to Washington, where, May 5th, he addressed the Geological Society of Washington upon the subject, 'Notes for a correlation between the Tertiary Volcanic Succession in Northwestern Europe and in Western America.' At the close of the lecture he was tendered a reception at the rooms of the U. S. Geological Survey. May 6th Sir Archibald visited Bryn Mawr College and briefly addressed the students, and May 7th lectured before the Philosophical Society in Philadelphia upon 'Recent Geological Work in the Hebrides and Faroe Isles,' after which the Society entertained him at a conversazione, at which many visiting geologists were present. May 8th he reached New York, and, aside from courtesies privately extended, was occupied with the rich collections of the American Museum of Natural History. May 10th he lectured in Brooklyn on the 'Geology of the Inner Hebrides,' and passed the remainder of the week in visiting Yale University and relatives in Connecticut. Saturday, May 15th, he sailed for England, accompanied by a cordial 'bon voyage' and an 'auf wiedersehen' from his many friends in America.

J. F. KEMP.

COLUMBIA UNIVERSITY.

*NOTES FOR A COMPARISON BETWEEN THE TERTIARY VOLCANIC SUCCESSION IN NORTHWESTERN EUROPE AND IN WESTERN AMERICA.**

After alluding to the remarkably complete record of volcanic action in Britain, the lecturer proceeded to describe the most extensive and best preserved of all the volcanic series which is referable to Tertiary time and is remarkably developed from the south of Antrim through the inner Hebrides and Faroë islands to Iceland and Greenland. A general sequence has been noticed in the character of the erupted material. The earliest lavas appear to have been basalts, followed by andesites and, lastly, dacites. The basalts form extensive plateaus, each of which is built up of nearly horizontal sheets. The intrusive rocks included gabbros, ranging into peridotites and other basic materials, granophyres, granites, rhyolites and other acid rocks; the latest intrusions of all returning to the original basaltic type.

The earliest chapter in the Tertiary volcanic history of northwestern Europe brings before us the gradual building up of extensive plateaus of basalt which, in some places, reach a thickness of more than three thousand five hundred feet. These vast outflows of lava appear to have issued chiefly from fissures, like those of Iceland, but with occasional vents, some of which built up cones like those on the surface of the Tertiary lava fields of western America.

The general characters of the Scottish basaltic plateaus were illustrated by a series of lantern slides, and some examples were also given of Icelandic fissures, particularly of the great fissure which supplied the vast lava floods of 1783.

From the great antiquity of these Tertiary lava plateaus they have undergone extensive denudation and dissection, so that their structure is laid bare along many miles of picturesque coast line as well as on the mountain ranges of the interior. Examples of the results of subaëreal waste were displayed on the screen.

Continuing, the lecturer said that when the basalts had accumulated to a great thickness the magma appears to have found easier passage between the strata at the bottom of the volcanic series than upward through fissures; consequently, sheets or sills are found intercalated among the Jurassic rocks which form the base on which the volcanic series rests, while the lower portions of that series have been similarly invaded.

The next epoch in the volcanic history reveals to us the uprise of an infinite number of successive intrusions of basic material in sills, dikes and laccoliths at certain points in the midst of the basalt plateaus. On the whole, these masses consist of gabbros and dolerites, but they included also some beautiful examples of peridotites. There is no evidence that any of these intrusions reached the surface and appeared there in the form of lavas. They seem to have risen by preference at certain points of weakness, such as groups of vents. Examples of the relation between the gabbros and vents of different sizes are particularly observable in the islands of Skye and Mull.

Illustrations of the scenery of the gabbro bosses were shown by means of slides, together with a portion of the crest of the Cuillin Hills, to show the intricate manner in which the material had been injected. There was probably a long interval after the cessation of the gabbro intrusions. When the volcanic energy resumed its activity the composition of the underlying magma had completely changed. Rocks of a thoroughly acid character were now intruded. They took the form of bosses, sills and dikes, but there is no

*Abstract of a lecture by Sir Archibald Geikie given before the Geological Society of Washington on May 5th.

proof in any case that they flowed out at the surface as lavas. Like the gabbros, they were developed in special centers and preferentially in the areas already chosen by the gabbros; hence, the black, rugged mountains of gabbro are very generally accompanied by more or less regularly formed cones of granite and granophyre. These two cones not only form a striking contrast to the gabbros as regards their contour, but also in their colors. They range through various tints of yellow and russet. The characteristic scenery of central Skye, with the dark, rugged outlines of the gabbros on the west and the smooth, pale cones of the Red Hills on the east, depends upon this difference of geologic structure.

The latest phase in the volcanic history is marked by the uprise of another great series of basic dikes which, like those of the earlier time, follow a generally northwesterly direction and rise even through the latest masses of granophyre. On the flanks of the Red Hills of Skye long, dark ribs of rock may occasionally be seen even from a distance, which mark the last efforts of the Tertiary volcanoes of Britain.

W. F. MORSELL.

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*SOME PHASES OF WEED EVOLUTION.**

THE common statement that "a weed is a plant out of place" is by no means satisfactory or final to the student. He is still left to ask how it is that certain species have such pronounced ability for getting out of place. Almost any plant may accidently get where it is not wanted, but comparatively few usually and persistently get in the way. A bad weed species is aggressive and persistent. What qualities make it so?

As a partial answer I would suggest four life attributes as follows: 1. Great reproductive power. 2. Good provision for dissemination. 3. Various protective expedients. 4. Variability.

The statement that a species, to rank as a bad weed, should have large reproductive power needs no elucidation. It is not even necessary to demonstrate that weed species are thus equipped. Dozens of striking examples will occur at first thought.* We should also remember that many of the worst weeds have a double resource for their multiplication; *i. e.*, they propagate themselves by buds as well as by abundant seeds. The Hawkweed throws out stolons; and a Canada Thistle chopped into 20 pieces by the hoe becomes 20 Canada Thistles.

It is also axiomatic that facility of dissemination is one of the qualities of a weed species.

Some weeds make headway by means of special contrivances for avoiding disaster. Certain ones can withstand hard drought. Others have such deep roots as to be beyond the reach of ordinary cultivation. The Dandelion, often cut down by the lawn mower, bears its feathery tuft of seeds on a stem so short as to escape the gardener.

But variability is the chief and most significant quality of a weed species. Moreover, variability is ultimate. And those characteristics already mentioned are all involved in variability; for each one—reproduction, dissemination, protection—may vary, and through selection be indefinitely modified. In this sense, however, variability is not coordinate with the other qualities mentioned.

Other things being equal, then, that species which is most variable is apt to become a weed. This point may be illustrated, though perhaps not demonstrated by reference to some statistics of weed floras. Thus, starting with the proposition that variability is roughly proportional to the number of members in a systematic group,

*Notes from a lecture before the University of Vermont Botanical Club.

*cf. Kerner, 'The Natural History of Plants,' II., 878.

our hypotheses would lead us to the inference that the larger groups would show comparatively large quotas of weed species. Is the inference true?

Professor G. H. Perkins' Flora of Vermont enumerates 114 families of Phænogams and Pteridophytes in the State. Thus if the species were equally divided among all the families each family would include .87 per cent. of the total flora. The great family of Composites, however, contains 10.33 per cent. of all the species in the State. Now, if it contained its fair proportion of weeds it would have about the same percentage. The fact is, it contains 21.43 per cent. of all the weeds and 33.33 per cent. of all the very bad weeds. This family, at any rate, bears out the theory.

These figures with some others appear in the following table:

SOME VERMONT WEED SPECIES.

Family.	Per cent. of total Flora.	Per cent. of total Weeds.	Per cent. of bad Weeds.
Cruciferæ.....	3.00	6.25	16.67
Leguminosæ.....	3.33	4.47	5.55
Rosaceæ.....	4.58	4.47	5.55
Compositæ	10.33	21.43	33.33
Gramineæ.....	9.42	8.93	11.11
5 Families (5×.87 =4.35 %	30.66	45.55	72.21

That is, these five great families include nearly one-third the Vermont flora, but nearly one-half the weed species and nearly three-fourths the very bad weeds.

Of course, this does not demonstrate the proposition and there are perplexing exceptions. Thus the largest family in the Vermont flora, the Sedge family, contains not a single species which could be reckoned among the weeds. Nevertheless the family is eminent both as to variability and potential weediness. The sedges crowd out pretty much everything else on their own ground, and it is only because the agriculturist seldom enters their favorite territory that their pernicious possibilities do not become realities.

Attention may also be directed to the fact that many bad weeds have escaped from cultivation. Since cultivation usually induces variability, we may suspect that this has been one source of aggressive power in some weed species.

Dr. Asa Gray * pointed out that both our introduced and our native weeds are, to a very great extent, cross-fertilized. This is the more striking taken in connection with the accompanying statement that most of them are, nevertheless, capable of self-fecundation. The latter capability protects them from extinction when cross-pollination is impossible, and the former provision gives rise to effective variability when other plants of proper relationship are near.

Another surprising fact in the natural history of our weeds is the very large proportion of species introduced from Europe. In a list of the twenty worst weeds of New Jersey, prepared by vote, under the direction of Dr. Halsted, there were elected to the twenty highest degrees of noxiousness four natives and sixteen foreigners. I have examined a similarly-prepared list of the eighteen worst weeds of Vermont. This included four indigenous species and fourteen foreigners.

Such a plain fact as this ought to have some intelligible explanation. Dr. Gray, in his paper mentioned, sets down a common reason, namely, that, since the greater part of the Eastern States was originally tree-clad, the native species were such as thrive under forest protection. They are, therefore, unable to make their way in the cleared fields against immigrant species which have been inured to such conditions by centuries of thrifty practice in the open fields of Europe.

But a stranger fact of weed history exists

* *Am. Jour. Sc. and Arts*, 3d Ser., XVIII. (1879), 161. Reprinted in 'Scientific Papers of Asa Gray.'

in the number of species, of which there are several, which have come from Europe with comparatively clean passports to become aggressive and troublesome in America. This is the case with the Hawkweed (*Hieracium aurantiacum*, Linn.), which is just coming into prominence in some parts of Canada and the Northeastern States.* There are two reasons for this: First, the comparatively very rapid changes, which practically all America has undergone, have largely destroyed the natural equilibrium of species, and this has made it easier for capable weeds to creep in. Second, the principle pointed out long ago by Darwin as 'the good derived from slight changes in the conditions of life,' applies to the case of plants imported from Europe. This 'good' accrues to the species through induced variability.

Even more interesting points of inquiry are revealed when we turn to study the migrations of weeds within the United States. Merely as a suggestion for further work, I have made a few comparisons between Eastern weed floras and that of Kansas. Professor A. S. Hitchcock † enumerates 209 species of Kansas weeds, of which only 51 are foreigners against 158 natives. Even then nearly all the foreign species are specifically stated to be rare in the State. In my own list of the 20 worst weeds of Kansas, instead of the remarkable proportion of foreign species noted in Vermont and New Jersey, there are 6 foreign and 14 native species. It is also interesting to note that exactly half this list is made up of native composites. Of course, we may expect that, as commerce goes on between Kansas and the Atlantic States, the proportion of foreign weeds westward will increase; but we may feel confident that the Daisy, the Hawkweed, and the Kales will find no such easy time making headway against the sunflowers and ragweeds of Kansas as they have had against the modest, shade-loving species of the Eastern States. The native species of Kansas have been used to live in the open country, exposed to fire and drought and browsing herds of buffalo. Now when they find a well plowed field, with perhaps a little irrigation, they are fully prepared to occupy the ground and hold their own against the world.

Then there is the question of these Western species coming east. Sixty-five years ago *Rudbeckia hirta* was unknown east of the Alleghenies, yet now it is widely distributed in the Eastern States. *Coreopsis tinctoria*, Nutt., is a Western Composite and a bad weed, now much cultivated in gardens in America and Europe. From these it has already shown a tendency to escape, and may be counted as a coming weed. *Dysodia chrysanthemoides*, Lag., is said to be coming rapidly eastward. *Artemesia biennis*, Willd., also belongs to this list, and has recently been collected in the railroad and dock yards at Burlington, Vermont. This list might be greatly extended.

It seems probable that the great and variable and geologically modern family Compositæ is destined to play an increasingly important part in the future transformations of American weed floras, and that its representatives will be especially prominent among the successful native weed species, as, indeed, they already are in the weed floras of the Mississippi Valley States.

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*See Vermont Exp. Sta. Bull. 56 (1897).
†Kansas Exp. Sta., Bull. 57 (1896).

THE EFFECT OF THE DENSITY OF THE SURROUNDING GAS ON THE DISCHARGE OF ELECTRIFIED METALS BY X-RAYS.

IT has been found that the rate of discharge which occurs when X-rays strike upon a charged body is affected by the pressure of the gas surrounding such a

body. Certain contradictions concerning this variation which have been made by different experimenters indicated that it would be worth the trouble necessary to study this phenomenon with care. Perrin (C. R. 123, 351 and 878) states that the rate of discharge is proportional to the density, while Benoist and Hurmusezcu (C. R. 122, 926 and 123, 1265) state that the rate of discharge is proportional to the square root of the density. The only data given in any of these statements are those in one of the articles by Benoist and Hurmusezcu. They determined the rate of discharge by noting the time it took the leaves of an electroscope to fall from a given initial position to a given final position. The voltage to which the electroscope was charged is not given, but presumably it was large. The curve marked B. & H. in Fig. 1 gives the results of their experiments.

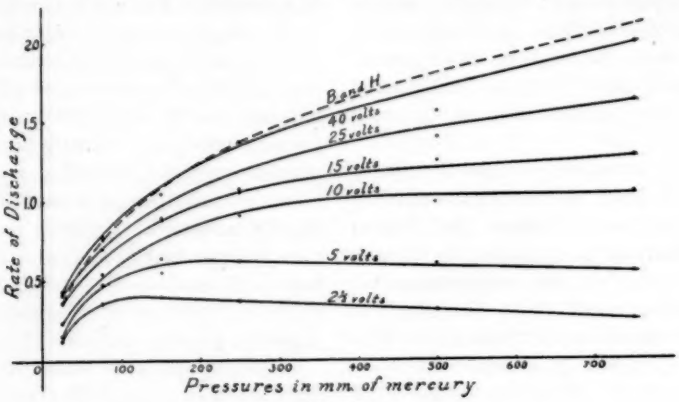

FIG. 1.

In experimenting along this line it was soon found that the curve given by plotting rates of discharge as ordinates and densities of air as abscissæ did not have the same form under all conditions, and while it may under certain conditions obey the law of Benoist and Hermusezcu, and may possibly under other conditions approximately obey that of Perrin, in general it does not obey either law.

The experimental work will be described more at length in the *Physical Review*, and only a brief account of the results are here indicated. My apparatus consisted primarily of a charged zinc plate and an electrometer. The plate was placed inside a box of the same metal from which it was insulated. The plate was connected to the electrometer and the box was ground, and both plate and box were placed in an air receiver which was connected to an air pump and a monometer. The rays struck the charged plate at nearly grazing incidence.

Care was taken to avoid ordinary electrical leakage and electro-static induction due to the action of the induction coil, also to protect the electrometer and its connections from the action of the X-rays, and from the action of the air through which the X-rays had passed.

The zinc plate had an area of about 50 qc.; the sides of the box were 2 cm. from the plate. The capacity of the plate, the connections and a small condenser placed in multiple with the plate was about 400 electrostatic units.

The rate of discharge was found by noting the fall in potential when the rays were allowed to strike the charged body for a few seconds, usually four, and also by noting the fall in potential when the zinc plate was connected through a very high resistance to a constant source of potential and the rays were allowed to strike the plate continuously. The high resistance was secured by winding two wires about each other which were covered with cotton insulation. The resistance through the insulation was about 5,000 megohms. The results from these two methods were in as fully complete concordance as could be expected from the nature of the work.

That which had the most effect upon the relation between the rate of discharge and the density of the surrounding gas was the potential at which the discharge took place. Curves are given in Fig. 1 for the rates of discharge when the initial potentials were $2\frac{1}{2}$, 5, 10, etc., up to 40 volts. The ordinates indicate the number of volts that the charged plate fell per sec., and the abscissas indicate pressure in mm. of mercury. The difference in the essential character of these curves can be seen by comparing that for 40 volts with that for $2\frac{1}{2}$. The former obeys fairly well the law of Benoist and Hurmusezcu, that the rate of discharge is proportional to the square root of the density. This agreement is shown by plotting the rates of discharge as given by them. The curve thus found is practically the same as that for 40 volts. The curve for $2\frac{1}{2}$ volts obeys an entirely different law, having, in fact, a maximum for about 200 mm. pressure. This effect seems less improbable when we remember that the discharging effect for the ultra-violet reaches a maximum at about 200 mm.

It is known that a metal tends to assume a final potential different from zero when X-rays strike upon it. It was thought at first that this effect might be complicating the phenomena that were being studied, but care was taken that the plate from which the discharge took place was surrounded by a grounded plate of the same metal, and the final potential when the plate was disconnected from the source of the E. M. F. and the X-rays were allowed to strike upon it continuously varied so little from zero as to be entirely negligible.

It is evident that another set of curves could be plotted showing the relation between the rate of discharge and the E. M. F.

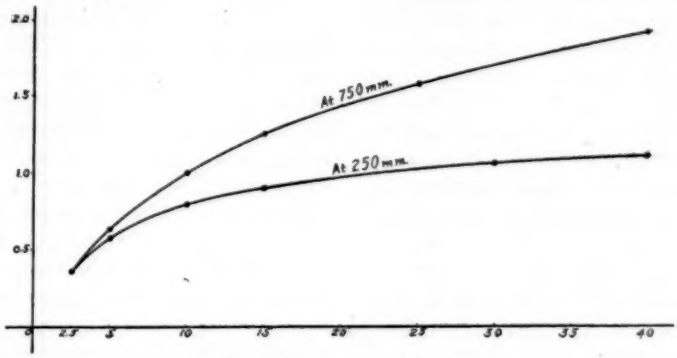

FIG. 2.

at different densities of the gas. Thomson and Rutherford (*Phil. Mag.*, 42, 392) and others have already studied this subject and shown that the current does not obey Ohm's law. As high E. M. F.'s are reached the current does not increase in a manner proportional to the increase in E. M. F. In Fig. 2 I have plotted such a set of curves, and it will be noticed that the form of the curve is not the same for different densities of the gas. Thomson and Rutherford have shown that the form of curve is not the same in the cases of air and hydrogen. The curve for air as given by them (Ibid, p. 404) is similar to the curve given in Fig. 2 for normal density of the air. That for hydrogen is similar to that given in Fig. 2 for pressure of 250 mm. However, it can scarcely be said that the form of the curve depends upon the density of the gas. The curve for mercury vapor as given by Thomson and Rutherford does, indeed, differ from that given for air in the opposite manner from that for hydrogen, but their curves for chlorine, sulphuretted hydrogen and air coincide in form, and the densities of these gases differ widely. They infer from their theory of this action "that more conducting particles are produced by the rays in air than in hydrogen, but that the product of U, the velocity of these particles, and T, a time which is proportional to the time these particles linger after the rays are cut off, is greater for hydrogen than it is for air." It is altogether possible that the same explanation may apply to the case where the same gas is used at different pressures. However, experiments to prove this would certainly be desirable. They also state that "the gases which have large saturation curves are those which contain the elements which have abnormally large specific inductive capacities in comparison with their valency." This remark does not seem to apply to the case where the same gas is used at different pressures. The saturation currents here do differ, and it is hard to see how either the specific inductive capacities or the valencies can differ for air at different densities.

It has also been found that the form of the curve between rates of discharge and density of air is different for different intensities of the rays. The curves which have already been plotted were taken with the tube near to the plate to be discharged. A series of curves were also taken with the tube at some distance from the plate and several inches of board placed between the two. These curves were somewhat similar to those shown in Fig. 1, but there was not as marked a difference between the curves for different potentials. In fact there was no curve which showed a maximum for pressures less than atmospheric pressure. It, therefore, seems scarcely advisable to try to get the form of the curves with any great degree of accuracy at present, for the form depends upon the intensity of the rays and there is no way of determining this intensity in any standard unit. I can define the intensity no better than I have already defined it in stating the rate of discharge which it produces from a zinc plate of given area with an approximate guess at the number of units of capacity in the system of plate, condenser and connections.

It has been stated by Perrin (C. R. 124, 454) that the discharge effect can be separated into a surface effect between the gas and the charged metal, and a volume effect throughout the gas. It was, therefore, thought that covering the zinc plate with a thin film of paraffin might change the form of the curve when the density of the air is changed. This was tried and no such change was noticed. It has not been possible to keep the action of the tube exactly constant, and so one cannot be entirely sure of the correctness of the results, but if coating the zinc plate with paraffin causes any change in the form of the curve it is at least small.

The plate to be discharged was then placed in the shadow of an opaque obstacle, and rays allowed to strike only the air near the plate. The form of the curve was not different from that obtained when the rays were partially screened off from both the plate and the surrounding air. These two experiments do not corroborate the theory of Perrin as given above.

It is also to be noted that the conditions in this last experiment were similar to those under which Perrin worked when he found the relations between the rate of discharge and the density of the gas, but the results which I found did not agree with the law as given by him.

There is also a fact in connection with this work which is worthy of note, although it does not directly bear upon the experiments here described. After the discharge had taken place the plate would often appear to recharge to a very noticeable degree. The electrometer used was a 'dead beat' electrometer. The recharging seemed to be more noticeable when the original potential was small, and the intensity of the rays great. My apparatus is not well adapted to study this phenomenon, nor have I had the time to do so. I hope hereafter to give a better proof of the existence of this phenomenon than I can at present offer, and to study the conditions under which it occurs more fully.

The experiments which I have described indicate a conduction effect through the gas rather than a convection effect due to particles thrown off from the discharging plate, but it would seem scarcely advisable to attempt to form a theory to explain these phenomena until they have been studied more completely.

Since writing the preceding I have investigated more completely the dependence of the rate of discharge caused by X-rays upon the potential used at different pressures of the surrounding gas. I find that the limiting value of the current is sooner reached when the experiment is carried on at low pressures than it is at higher ones, and that the limiting values, called by Thomson and Rutherford saturation points, are roughly proportional to the square roots of the density of the gas.

Stoletow (*Journ. de Phys.* 9, 471) found that in the case of discharge caused by ultra-violet light the pressure of the gas at which a maximum effect occurred was proportional to the potential with which he was working. I have tested the discharge caused by the X-rays in this respect, and for this purpose I used much greater intensity of radiation than I had previously used. I found the pressure for maximum effect to be roughly proportional to potential of the charged plate. Also the intensity of the rays has a very great effect on the point of maximum effect. The greater the intensity the lower was this point.

I have also tried allowing the rays to strike the charged body at normal incidence, and the results were the same which I had previously found when the incidence was grazing.

C. D. CHILD.

CORNELL UNIVERSITY.

CURRENT NOTES ON PHYSIOGRAPHY.

CORNISH ON SAND DUNES.

MR. VAUGHAN CORNISH discusses the formation of sand-dunes (*London Geogr. Journ.*, IX., 1897, 278–309), and throws much light on their growth and movements. Basing his work on observation and experiment he discusses the effects of supply and texture of sand and of direction and strength of wind, and reaches satisfactory explanations of transverse, longitudinal and crescentic dunes (*barchanes* of Arabia, *medanos* of Peru), adding a suggestive hypothesis for the origin by wind-excava-

tion of the Arabian sand pits (*fulje*) of hoof-print form. Some of these described by Blunt are over 200 feet deep, revealing the hard floor on which the loose sand lies. The horns of the crescentic *medanos* point in the direction of wind motion, because, being lower than the middle, they travel forward faster, and thus run ahead of the larger mass. The extension of coast dunes in ridges transverse to the active winds is shown to depend more on the location of the sand supply (the beach) than on wind intention or 'sand tactics.' The longitudinal dunes of the Indian desert, parallel to the dominating wind, exhibit the more perfect mastery of the wind over the sand; they are best developed where the wind is strongest. Transverse dunes are compared to large ripples of sand and exhibit the relative mastery of the sand over the wind. The most effective way to check the encroachments of blown sands is to promote the growth of existing dunes by wattle fencing; thus the advance of individual dunes and the formation of new dunes to leeward are retarded.

PHILIPPSON ON GEOMORPHOLOGY.

Dr. A. Philippson, of Bonn, has contributed a series of articles to Hettner's *Geographische Zeitschrift* (II., 1896, 512–527, 557–576, 626–639, 688–703), on the progress of the above subject, in which he recognizes two divisions: a dynamical chapter, concerned with the forces at work on the surface; and a systematic chapter, concerned with the classification of forms according to their characteristic features and their causes. Geological structure and stage of development (by which young, mature and old forms are distinguished) are not given prominent place. Attention is devoted chiefly to the processes by which form is determined; weathering, transportation by streams, snow, ice, and wind, and the action of the sea, are considered in some detail, with numerous references to special articles; geomorphogeny, rather than geomorphology, being the leading theme. For example, under transportation by gravity, the determining conditions of landslips are briefly stated, but entirely apart from the structures and the stages of development in which landslips are characteristic and with little attention to the forms that they assume. While rational from the point of view of process, such a method seems empirical from point of view of form and, as such, characteristic of the current German method of study.

THORODSSEN ON NORTHEAST ICELAND.

K. Keilhack gives an abstract in Petermann's Mitteilungen (XLII.,1896, 269–275) of Thorodssen's observations in northeastern Iceland in 1895. The Jokulsa delta formerly had a larger population, but is now in part laid waste by the gravels of its aggrading distributaries. South of the delta flat lava floods of great area spread around cones of moderate height; the lavas are seen to rest on glaciated dolerite. Indeed, all northeast Iceland bears marks of glaciation where not covered by younger lava flows and ashes. Fissures are noted at various points. East of the Jokulsa delta the broken ground is dislocated on the fissures. Lava flows issue from some fissures, and small craters are built over them. West of the delta fissures were formed during the earthquake of January 25, 1885, with small displacement of adjacent land blocks. The younger lava and tuffs of this region, both pre- and post-glacial, continue southward to the Vatna Jokull, apparently occupying a depressed district between the older basalts to the east and west.

VOLCANIC PHENOMENA OF 1894.

E. Rudolph, of Strassburg, continues the annual report on volcanic phenomena, previously prepared by Knüttel (Tschermak's Min. u. Pet. Mitth., XVI., 1896, 365–464).

A special bibliography is given for each important volcanic district, followed by a brief summary of events, with frequent historical review. From an abundance of material the following may be noted: Falcon island in the Friendly (Tonga) islands (20° 20′ S. lat.; 175° 20′ W. long). was first noted as a shoal in 1867. In 1877 smoke was seen ascending from the sea surface over the shoal. In October, 1885, an island had been formed 3,700 meters long and 75 meters high. At this time a terrific eruption was in progress, enormous clouds of constantly changing form rising over the island; earthquakes were felt on the neighboring islands and thundering sounds were heard on the southernmost island of the Fiji group, 325 kilometers away. In 1886 the island was estimated as 2,600 meters long and 50 meters high; in 1887 the height was 90 meters. In 1889 the length and breath were 2,040 and 1,630 meters; the height was 47 meters. The adjacent sea bottom was 1,800 meters deep. The island consisted of ashes and has subsequently been greatly reduced by wave action. In 1892 its height was only eight meters, and its disappearance may be soon expected.

LIMESTONE RANGE OF THE KLONTHAL, SWITZERLAND.

DR. CARL BURCKHARDT, a pupil of Heim's, contributes the 35th number of the Beiträge zur Geologischen Karte der Schweiz (Monographie der Kreideketten zwischen Klönthal, Sihl und Linth; Bern, 1896, 205 p., maps and plates). It concerns a small district in which the structural features of successive eastward portions are, as it were, out of joint with each other; this being explained as the effect of a folding and shearing on north-south lines, oblique to another folding on roughly east-west lines. Most of the report is given to stratigraphy; the later pages treat *Oberflächengeologie*, but less thoroughly than could be wished. A more detailed analysis of drainage lines might serve to determine the relative date of the two systems of folding, which is left in doubt. A characteristic feature of the work is a number diagrammatic views, drawn from nature by the author in a style closely resembling that of his master.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

NOTES ON AMERICAN CERAMICS.

THE device of the potter's wheel was unknown in either North or South America. A substitute for it is described as still in use among the Araucanians of Chili. It is a convex dish which is moved backward and forward on a smooth stone. Revolving in it, the clay is moulded to a symmetrically circular form. (*Globus*, Feb. 20.)

A cylindrical mug, with a handle, quite like a German 'Bierseidel,' was manufactured by the ancient Araucanians, as the same authority tells us; and it is singular how exactly this form recurs in the pottery of the Cliff-dwellers. Numerous examples are in the Museum of the University of Pennsylvania.

Intentional glazing was probably nowhere developed into a branch of ceramic art on this continent; but partially glazed specimens, of ancient date, are not unusual in Central American collections. Examples are in the Museum just mentioned. They seem to be accidental, owing to an abundance of siliceous matter in the clay.

THE RACIAL GEOGRAPHY OF EUROPE.

THE series of articles on this subject by Professor W. Z. Ripley, in the *Popular Science Monthly*, deserves the attention of all readers interested in questions of modern anthropology. The Europeans of to-day offer a peculiarly complicated problem, owing to the extensive crossings to which all

the types have been subjected. Professor Ripley undertakes its solution by an analysis of each of the ethnic elements, such as language, skull-form, complexion, hair, stature, etc. Numerous maps, diagrams, and photogravures put the reader at a glance in possession of the relative localization of these traits. The theories of their origin and distribution, as advanced by the principal students of the subject, are brought forward and examined. The author evidences both a thorough acquaintance with the subject and a freedom from bias in reaching his conclusions which cannot fail to command for them the most careful attention.

ANOTHER INTERPRETER OF THE MAYAN HIEROGLYPHS.

It is a gloomy duty to chronicle the victims to the story of the Mayan hieroglyphs, but a duty it is.

One of the latest is Herr A. Eichhorn, of Berlin. He has discovered that about 24,000 years ago the ancestors of the Mayas dwelt on an island in a now dried-up lake in Central Asia. They there developed a science of astronomy, mathematics and philosophy, which they embalmed in their heraldric insignia, their hieroglyphs and in the grammatic and etymologic construction of their languages. On reaching Central America, say about 12,000 B. C., they continued their relations with Europe until 1500 B. C., the Pelasgi and Leleges being really Mayas. About the ninth century of our era the Northmen visited Yucatan, and brought from there the Gothic style of architecture into Europe. Mayas, Nahuas and Toltecs are, in fact, the same people and speak the same secret language, as Mr. Eichhorn proves by an analysis of many words. Their common calendar system he explains with ease. It is entirely theosophic and symbolic.

Does the reader wish more? Then let him buy Mr. Eichhorn's work, a handsome quarto of 128 pages, entitled 'Naual, oder die hohe Wissenschaft der architectonischen und kunstlerischen Composition bei den Maya-Völkern.' (Berlin, Max Spielmeyer.)

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

A study of ozone from a technical standpoint by E. Andreoli appears in the *Journal of the Society of Chemical Industry*. Theoretically, one should be able to produce a kilo of ozone per electric horse-power, but in practice only ten or twelve grams are obtained. By improvements in the apparatus for producing ozone, the author increases the production to thirty and even fifty grams per horse-power, making the cost of ozone about three shillings a kilo. Among the improvements in the apparatus are passing the air directly between the electrodes, thus avoiding two glass dielectrics; a minimum distance between the electrodes, made possible by discarding the glass dielectrics; increase in surface (and number) of electrodes; use of electrodes covered with numerous sharp points. The author proposes a large number of technical applications of ozone, such as purification of drinking water, cleansing of beer casks, preparation of wood for instruments and furniture, bleaching of starch and dextrin, oxidation of drying oils, purification of wine and brandy, etc. It does not appear, however, that any of these proposed uses have been tested practically and on a large scale.

An investigation, by S. A. Andrée, of the amount of carbon dioxid in the atmosphere, abstracted in the *Chemisches Central-Blatt*, shows but slightly varying quantities at different elevations. Air collected on a balloon ascent from the height of 1,000 to 3,000 meters contained 3.23 parts carbon dioxid per 10,000; from 3,000 to 4,300

meters, 3.24 parts, while at the earth's surface the amount is 3.03 to 3.20. Nansen found, when crossing Greenland, that at elevations of 2,300–2,700 meters, and with a temperature of –20°, the amount of carbon dioxid was as great or even greater than at Stockholm. It seems now well settled that the old figure of 4 per 10,000 as the content of the atmosphere in carbon dioxid is decidedly too large, and that the amount varies locally within quite narrow limits, but with a tendency to increase slightly with the elevation. The cause of this variation is, as yet, unexplained, but the consumption of the gas near the surface of the earth by plants would seem to be a factor.

A SERIES of experiments on the resistance of cements to sea water was begun in 1856 at the harbor of La Rochelle, and is described in the *Thonindustrie-Zeitung* by E. Candlot. The experiments consisted in placing cubes of cement of different compositions, 60 centimeters long, where they would be covered by the sea at high tide and exposed to the air at low water. Blocks of cement without sand disintegrated more rapidly than those containing sand, and the best mixture was one volume of cement with from one to two volumes of sand. Such blocks lasted from twenty to thirty-eight years. This mixture corresponds to the least porous material, that is, the cement suffices to completely fill the interstices between the grains of sand. An excess of lime or magnesia in the cement is detrimental; this occurs when the quantity of silica and alumina is insufficient to saturate these bases. The best cement is that which requires least water for mixing, relative to the amount which it can hold chemically combined when 'set.' Portland cement was found to require very little excess of water, and hence gave the densest and least porous results and the maximum durability.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

A PERMANENT CENSUS BUREAU.

WE are glad to note that Senator Chandler, Chairman of the Committee on the Census, reported favorably, on May 10th, the bill providing for taking the twelfth census and for the establishment of a permanent census service. This bill was drawn up by the Hon. Carroll D. D. Wright, Commissioner of Labor, in accordance with a joint resolution of Congress, and demonstrates the advantages of securing expert scientific advice in regard to proposed legislation. The main provisions of the bill are as follows:

It provides for a permanent census office at Washington, the duties of which shall be the taking of the twelfth and succeeding decennial censuses and the collection of other statistical information in intervening years. The Director of the Census and the Assistant Director are to be Presidential appointees, but the latter must be an experienced practical statistician. The other officers, including five chief statisticians at an annual salary of $3,000 each, will be appointed under the civil service rules.

The sum of $75,000 is to be appropriated for the organization of the office. It is estimated that the annual cost will be less than $500,000, and that the decennial enumeration with the tabulation of results will cost an additional sum of about three or four million dollars. The permanent census bureau would consequently cost less than the eleventh census, for which some eleven and a half million dollars were expended. It is estimated by Mr. Wright that two million dollars of this sum can be charged directly to the fact that the force was not under civil service rules.

The bill provides for taking the census hereafter on April 15th in place of June 1st, as at the latter date the people are scattered from the cities. It is proposed to omit from the decennial census certain items regarding vital statistics, mortgages, Indians, etc., included in the eleventh census, these being in part relegated to other bureaus and to the separate States. The office would, however, issue annually accounts of agricultural products and biennially accounts of manufactures. Statistics of deaths and births would be obtained from the registration records

of the separate States and municipalities, supplemented by such data as the Director of the Census may think it advisable to secure. Statistics relating to the dependent, delinquent and defective classes would be published annually. It is hoped, further, to secure a quinquennial census of the population with the cooperation of the States.

ELIZABETH THOMPSON SCIENCE FUND.

THIS fund, which was established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, 'for the advancement and prosecution of scientific research in its broadest sense,' now amounts to $26,000. It is under the care of a board of trustees consisting of Henry P. Bowditch, President; William Minot, Jr., Treasurer; James M. Crafts, Edward C. Pickering and C. S. Minot, Secretary. As accumulated income will be available in November next, the trustees desire to receive application for appropriations in aid to scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance.

Application for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points: (1) Precise amount required. (2) Exact nature of the investigation proposed. (3) Conditions under which the research is to be prosecuted. (4) Manner in which the appropriation asked for is to be expended. The trustees are disinclined, for the present, to make any grant to meet ordinary expenses of living or to purchase instruments, such as are found commonly in laboratories. Decided preference will be given to applications for small amounts, and grants exceeding $300 will be made only under very exceptional circumstances. All applications should reach, before November 1, 1897, the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U. S. A.

GENERAL.

THE House of Representatives, on May 11th, by a vote of 100 to 39, refused to concur in the Senate Amendment to the Civil Service Sundry Bill, revoking President Cleveland's order regarding the forest reservations. Both the House and the Senate are evidently in favor of the inauguration of an adequate forestry policy, and we feel sure that suitable arrangements will be made.

MR. GALLINGER has reported favorably, from the Committee on the District of Columbia, the bill 'For the further prevention of cruelty to animals in the District of Columbia.' It is to be hoped that this bill, which proposes onerous and useless restrictions on the advancement of the medical sciences, will not be passed by Congress. All the representative bodies most competent to form an opinion on the matter regard the proposed law as useless and harmful. These bodies include The National Academy of Sciences, the American Association for the Advancement of Science, the Academy of Natural Sciences of Philadelphia, and many other societies more competent than the Senate to decide whether any cruelty to animals has been practiced in the District of Columbia.

BY the death of the Duc d'Aumale, on May 7th, the Institute of France comes into possession of the Château of Chantilly with its great collections, a bequest valued at $8,000,000.

PROFESSOR B. K. EMERSON, Professor O. C. Marsh, Professor S. F. Emmons, Mr. J. E. Spurr, Mr. A. H. Brooks, Professor W. H. Hobbs and Professor J. P. Iddings, all of the United States Geological Survey, will attend the coming International Geological Congress in Russia. They will be officially accredited to the Congress as representatives of the United States, the delegation to include also Professor G. P. Merrill, of the National Museum.

PRESIDENT DAVID STARR JORDAN, Mr. F. A. Lucas and Mr. Leonhard Stegneger will again this year act as commissioners to investigate the condition of the seals, and will leave for the Pribyloff Islands on or about the 1st of June.

THE Civil Service Commission announces a competitive examination to fill a vacancy in the

position of anthropologist in charge of the Division of Anthropology in the United States National Museum. The duties of the position will be the administration of the division of anthropology and the carrying forward of original investigation and study of the collections. The salary is $3,500 per annum. Competitors will be required to submit their answers to the inquiries and their essays on blanks furnished them by the Commission on or before June 1st.

AT a meeting of the Council of the Australasian Association for the Advancement of Science held at Sidney on March 25th it was decided that the commencement of the next annual session be fixed for January 6, 1898. It was decided further to suspend the rule requiring an initiation fee from new members. The Hon. Secretary, Professor A. Liversidge reported that he had written to the Premier quoting the amounts of pecuniary and other aids afforded in the past to the Association by the respective governments of Victoria, New Zealand, Queensland, Tasmania and South Australia, and asking for similar support from the mother colony. Professor Baldwin Spencer, of Melbourne University, will deliver a popular lecture at the meeting on 'The Center of Australia,' with special reference to its ethnological aspects.

A MEETING of the International Committee of Weights and Measures was held at Sèvres, near Paris, beginning on April 13th. Dr. Wilhelm Förster, Director of the Berlin Observatory, presided, and there were representatives present from Germany, Austria, England, Russia, Norway, Switzerland and Portugal.

AN International Congress for the unification of methods for the testing of materials will be held at Stockholm on the 23d, 24th and 26th of August of the present year.

THE Russian National Health Society proposes to celebrate, next year, the 100th anniversary of the discovery of the mineral springs of the Caucasus by a conference on balneology and climatology.

THE current number of *Nature* contains the thirtieth article in the series on 'Scientific Worthies.' The subject of the present article is the eminent Italian chemist, Professor Stanislao Carmizzaro. The text, by Dr. T. E. Thorpe, is accompanied by a fine portrait.

THE Paris Academy of Sciences has nominated as its first choice, M. le Colonel Bassot; as its second choice, M. Lippmann, for the position in the Bureau of Longitudes, vacant by the death of Fizeau.

THE Paris *Société de secours des amis des sciences*, a society whose object it is to assist poor scholars and their families, held its annual meeting on April 29th, under the presidency of M. Joseph Bertram, who made an address on 'The life of a scholar in the sixteenth century.'

THE New York State Forest Preserve Board, which has the important duty of buying $1,000,000 worth of Adirondack lands, held its first formal meeting on May 7th. Its members are Lieutenant-Governor Woodruff, State Engineer Adams and Forestry Commissioner Babcock. There were submitted to the Board offers of land in the Adirondacks amounting to over $1,000,000 in value, a large part of which is on the southern slope of the Adirondacks, the region where the Board thinks the larger part of the appropriation should be spent.

THE American Academy of Arts and Sciences, at its annual meeting on May 12th, elected the following officers for 1897–98:

President, Alexander Agassiz; Vice-President, Class I, John Trowbridge; Vice-President, Class II, George L. Goodale; Vice-President, Class III, Augustus Lowell; Corresponding Secretary, Samuel H. Scudder; Recording Secretary, William Watson; Treasurer, Eliot C. Clarke; Librarian, Henry W. Haynes; Councillors, Henry Mitchell, Leonard P. Kinnicutt, Edwin H. Hall, in Class I; Henry P. Bowditch, William W. Davis, B. L. Robinson, in Class II; Barrett Wendell, John E. Hudson, Edward Robinson, in Class III.

At the same meeting the following persons were elected Associate Fellows: In the Section of Medicine and Surgery, William Osler, of Baltimore, and William Henry Welch, of Baltimore, and in the Section of Literature and the Fine Arts, Horace Howard Furness, of Philadelphia, and Edmund Clarence Stedman, of New York.

THE National Education Association meets this summer at Milwaukee, from the 6th to the 9th of July, which will be convenient for those

wishing afterwards to attend the meeting of the American Association at Detroit.

At the annual meeting of the New York Electrical Society, on May 20th, Mr. H. Baringer Cox was announced to lecture on the Thermopile, with practical illustrations of certain novel features.

The valuable ornithological collection owned by the late D. von Homeyere has been purchased in part by Dr. W. Blasius for the Museum of Natural History at Brunswick, and in part by Dr. R. Blasius for his private use.

The Appalachian Mountain Club, of Boston, has arranged for an excursion to Amherst, Mass., on May 21st to June 2d, and to Dublin, N. H., from June 16th to 21st. The Club gave an 'At home' on May 19th, at which a collection of mountain pictures lent by Mr. Charles Pollock was on view, and other pictures were shown, including photographs of the mountains of the moon taken at the Paris Observatory, views of the Rockies and of the wonderful Muir Glacier.

We regret to record the death of Mr. Hugh Nevill, of the Ceylon civil service, who had discovered and described many new species in zoology and made valuable collections in ornithology and conchology.

The Directory of Scientific Societies of Washington, for 1897, prepared and published by the Joint Commission, Mr. J. Stanley-Brown, Acting Secretary, bears witness again to the dominant position of Washington as a scientific center. The number of members of the several societies is as follows: Anthropological, 138; Biological, 156; Chemical, 89; Entomological, 41; Geographic, 1,040; Geological, 144; Philosophical, 120; the total membership of the societies being 1,728 and the total number of persons 1,450.

D. Appleton & Co. announce, as a new volume in their 'Useful Story Series,' *The Story of Germ Life*, by Professor H. W. Conn.

Lord Lister presided at the annual dinner of the Royal Literary Fund on May 5th, and the speeches made by Lord Lister, the Bishop of Stepney, Mr. Traill, Mr. Lockyer and the Earl of Crewe were all concerned with the relations of science to literature.

Professor H. Moissan will lecture at the Royal Institution, London, on May 28th, on the 'Isolation of Fluorine.'

Replying to a question in the British House of Commons, Sir Mathew White Ridley said that the number of persons licensed to practice vivisection at the present time in England was 145, in Scotland 52, and in Wales 1; the number holding the certificate dispensing with anæsthetics was in England 86, in Scotland 30, and in Wales none. The only figures in his possession as regards Ireland were those for 1895; in that year the number of licenses was 6, of whom one held a certificate dispensing with anæsthetics. In giving the honorable member these figures he might remind him that the certificate in question was never given for operations involving serious pain, but only for such operations as inoculations or hypodermic injections.

Governor Black has signed the bill authorizing New York City to make an additional bond issue of $2,500,000 for the erection and equipment of four high schools.

Dr. Kolle, of the Berlin Institute for Infectious Diseases, has received a year's leave in order to proceed to Cape Colony, where he has been commissioned by the Cape government to continue the work on rinderpest and leprosy begun by Professor Koch.

A portrait of Lord Lister by Mr. Ouless is said to be among the best pictures at the recently opened exhibition of the Royal Academy.

Though an egg of the Great Auk was sold at auction recently for nearly $1,500, it is by no means the rarest of birds, being positively common in comparison with the Labrador Duck and Pallas' Cormorant, and the extraordinary value attached to its remains is somewhat singular. An instance of this was shown at a sale in 1895, where an egg of the Great Auk brought 180 guineas, while a well preserved egg of Æpyornis sold for 36 guineas.

Dr. W. F. Morsell writes that the suites of typical rocks of the Educational Series which the United States Geological Survey has been preparing for several years are ready for distribution; and the higher institutions of learning,

to which they will go, have been notified of the fact. There are nearly 200 sets, of 156 specimens each. The institutions are expected to pay for transportation, but are under no further expense.

AT the last meeting of the British Astronomical Association it was announced by the President (Mr. N. E. Green) that Miss Brown, the Director of the Solar Section of the Association, had presented £50 towards the expenses of erecting an observatory on the site offered by the Royal Botanical Society. Mr. J. G. Petrie, (Secretary), stated that the President had offered to commence the equipment of the observatory by presenting his 18-inch reflecting telescope, with which he had made many of his drawings, and that Mr. Calver had also offered optical aid.

ON Saturdays in June and July, when the Royal Botanic Gardens are opened to the public by payment of a fee, gardeners will be detailed to take visitors around the gardens to show the points of interest and describe the plants.

THE fifteenth anniversary of the Institution of Mechanical Engineers, London, was celebrated by a dinner on April 29th. Mr. E. Windsor Richard, the President, occupied the chair, and speeches were made by the Duke of Cambridge, Sir F. Bramwell, Professor Kennedy and others.

The Psychological Index, compiled by Dr. Howard C. Warren, of Princeton University, and Dr. Livingston Farrand, of Columbia University, and issued annually as a supplement to *The Psychological Review*, has been published for the year 1896. The bibliography of the literature of psychology and cognate subjects for that year extends to 145 pages and contains 2,234 titles. Psychology is one of the fifteen sciences to be included in the International Bibliography of Scientific Literature, but, while the plans for this great undertaking are being matured, *The Psychological Index* is essential to students of psychology and cognate subjects.

THE first two numbers of a *Zeitschrift für Criminal - Anthropologie, Gefängniswissenschaft und Prostitutionswesen*, edited by Dr. Walter Wenge and published by M. Priber, Berlin, have been issued. These numbers include articles by Dr. Näcke on 'Lombroso and Modern Criminal Anthropology,' by Professor Preyer on the 'Hand-Writing of Criminals,' by Dr. Penta on 'The Rational Treatment of Criminals,' by Dr. Paul on 'Identification,' and other articles on similar subjects, together with a review of the literature.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Governors of McGill University, in accordance with the custom of British and Canadian universities, announce that they are prepared to receive applications for the appointment to the chair of zoology recently founded by Sir Donald A. Smith. The annual salary is $2,500. Candidates should forward applications with testimonials before June 1st to Mr. W. Vaughan, Secretary, McGill University, Montreal.

IT is announced that the College of Physicians and Surgeons of Chicago will be affiliated with the University of Illinois.

BARNARD College, New York, has received a gift of $140,000 from Mrs. Josiah M. Fiske for a building to be called Fiske Hall in memory of her husband. This will enable the trustees to complete the new quadrangle, the other halls, provided by Mrs. Brinckerhoff and Mrs. Anderson, being now nearly ready for occupancy. Barnard College has also received $6,000 from Mrs. Henry O. Havemeyer for the equipment of the chemical laboratory and $2,000 from others for the furnishing of the Brinckerhoff Hall.

ROSSE Hall, Kenyon College, was burned May 9th. The loss is estimated at $10,000.

THE chair of mineralogy and metallurgy in Columbia University, vacant by the retirement of Professor Thomas Egleston, will be divided, Professor A. J. Moses being promoted to a professorhip of mineralogy, and Mr. H. M. Howe, a graduate of Harvard University and the Massachusetts Institute of Technology, being appointed professor of metallurgy.

THERE are 450 candidates for degrees this

year at Cornell University. Of these 136 are in the department of arts and sciences and 137 in the Sibley College of Mechanical Engineering. There are 18 candidates for the doctorate, 14 in philosophy and 4 in science.

THE will of the late Miss Brown, of Waterhaugh, Ayrshire, leaves £5,000 both to the University of Edinburgh and to the University of Glasgow.

THE Cambridge Syndidate appointed to consider the question of degrees for women have issued a second report, in which they state that after carefully considering the discussion of their first report they adhere to their recommendations. The statute recommended is as follows: "The University shall have power to grant, by diploma, titles of degrees in Arts, Law, Science, Letters and Music to women who, either before or after the confirmation of this statute, have fulfilled the conditions which shall be required of them for this purpose by the ordinances of the University, and also shall have power to grant by diploma the same titles *honoris causa* to women who have not fulfilled the usual conditions but have been recommended for such titles by the Council of the Senate; provided always that a title granted under this section shall not involve membership of the University."

DISCUSSION AND CORRESPONDENCE.

FORMER EXTENSION OF ICE IN GREENLAND.

I HAD not intended writing on this subject again, but Professor Chamberlin's criticism* of my paper in the Bulletin of the Geological Society of America calls for a reply. For the benefit of those, if there are any, who think that problems of Greenland glacial geology can be settled at long range, by a comparison of photographs, I wish to point out that Professor Chamberlin has selected for publication, not the view in my paper, which *does show* some ruggedness, but one inserted primarily to show glaciated topography. Therefore I can agree with some of Professor Chamberlin's remarks.

Had my critic sailed along this coast he would have seen the Devil's Thumb as a high peak with serrated sky line, precipitous front and numerous evidences of ruggedness. He would not have seen the well glaciated back, which my view shows, and would not have known that, while in all other places the peak is inaccessible, the ascent from the glaciated back was easy. Had he made this ascent he would have found even more distinct evidence of ruggedness and, throwing a stone as large as one's head, would have found that from five to seven seconds elapsed before it struck, indicating a nearly sheer precipice of perhaps 500 feet. Whether this would have been classed as angular and unsubdued I cannot, of course, say; but my classification of it, in the view obtained from the sea, is distinctly unsubdued. Some idea of the nature of this west face (or left side) may be gained from the photograph, though the cliff is three or four miles from the camera and the picture, as printed, far less distinct than the original view. Dozens of hills in this region have the same characteristics, including Fig. I., plate 27 (in my article), in which, however, glaciated topography is seen in the background on the right, which would not have been seen from sea-level.

I have nothing to say concerning my query about the 'driftless area,' which, judging from the warmth of the reply, seems to be resented. Nor do I feel called upon to defend my use of the term Devil's Thumb. From Professor Chamberlin's remarks one would infer, what is not the case, that I had made an error in placing names. Geologists would be undertaking a very serious task if they attempted to verify the maps they use. The Ryder map, from which the name is adopted, is based on an *official Danish Survey*, and for the region is quite remarkably accurate. Since this map is published in my paper, and a foot-note announces my belief that Ryder has made an error in naming the mountain the Devil's Thumb, no real confusion will arise in the minds of those who read my paper carefully and candidly.

Professor Chamberlin makes another mistake when he says that I insist 'upon general glaciation.' I have never done this, but have brought forward evidence which, I believe, proves the opposite conclusion to be a generalization based upon questionable field methods,

* SCIENCE, p. 748, and in a somewhat different form in *Journ. Geol.*, V., 1897, p. 303.

so that the work ought to be done over before the conclusion can be accepted.

Since Professor Chamberlin has again and again mistaken my position, or has otherwise changed the point at issue, and since little of scientific value is likely to come of this discussion, I shall write no more upon this point.

RALPH S. TARR,

CORNELL UNIVERSITY.

POUDRÉ.

TO THE EDITOR OF SCIENCE: Mr. Goode's description of what he calls *Pseudo-Aurora* (SCIENCE, January 29, 1897), as seen by him at Moorhead, Minn., is abundantly confirmed by my own observations at this place. The complete manifestation of the phenomena is comparatively rare. The finest I ever saw was on January 22, 1890, an account of which was furnished by me at that time to the *American Meteorological Journal*, and published in the February number, and to which the title of this article was given by the editor, Mr. M. W. Harrington. From this article I condense the following extract: After a ten days' period of continued cold weather the thermometer reaching $-20°$ to $-32°$ at night, a south wind set in on the 22d, and the temperature rose to $+10°$. During the afternoon and evening the air seemed full of small ice crystals; and my recollection is that I examined them, and found them to be, as Goode describes them, minute, thin, perfectly clear, hexagonal ice-crystals. The reflection of street lamps and electric lights made long streams of light, *all tending to the zenith of the observer;* that produced by the electric light being so nearly like the Aurora Borealis as readily to be mistaken for it.

LUDOVIC ESTES.

UNIVERSITY OF NORTH DAKOTA, April 28, 1897.

EARLIEST PUBLISHED NOTE OF THE LATE CHAS. E. BENDIRE.

IN my obituary of Major Bendire, published in SCIENCE of February 12, 1897 (pp. 261–262), I stated that "his earliest published writings are in the form of letters to well-known naturalists, chiefly Allen, Baird and Brewer." While this statement is correct as it stands, the first letters mentioned by me were published in 1876. Dr. Coues calls my attention to an earlier note I had overlooked, one by himself in the *American Naturalist* for June, 1872 (p. 370), in which a quotation is given from a letter about a small owl, written by Bendire, from Tucson, Arizona. So far as I am aware, this is the earliest publication of any of Bendire's notes.

C. H. M.

SCIENTIFIC LITERATURE.

RECENT TEXT-BOOKS IN PHYSICS.

Elementary Text-books on Physics. ANTHONY AND BRACKETT. Revised by W. F. MAGIE. John Wiley & Son. Eighth edition. 1897.

The Elements of Physics. NICHOLS AND FRANKLIN. Volume III., Light and Sound. The Macmillan Co. 1897.

The Outlines of Physics. E. L. NICHOLS. The Macmillan Company. 1897.

Problems and Questions in Physics. MATTHEWS AND SHEARER. The Macmillan Company. 1897.

Intermediate Course of Practical Physics. SCHUSTER AND SEES. The Macmillan Company. 1896.

Experimental Physics. W. A. STONE. Ginn & Company. 1897.

First Principles of Natural Philosophy. A. E. DOLBEAR. Ginn & Company. 1897.

In view of the enormous number of new books, on all sorts of subjects, which are continually making their appearance, it is important to inquire whether book-makers, publishers and authors are not increasing at an abnormal rate. Indeed, it begins to look as if some check on their activity would shortly be necessary for the protection of those old fashioned people whose pleasure it is to read rather than to write books. At the present rate of book production it will not be long before that day, which has often been foretold, is actually at hand when every man will have time to read only his own works, and even now there must be some authors who are too busy for that.

The intellectual, and especially the scientific, activity of the present period is in some measure finding an outlet in the preparation of text-books for schools and colleges, and this is particularly true in the domain of the physical sciences.

It is easy for a teacher to convince himself that there is no existing book quite suitable for his work, and the feeling that he can make one which will meet his own wants and those of many other teachers is entirely natural. The result is a continually increasing number of texts, which are multiplying so rapidly that before long every class will be using that of its teacher for the time being, and no more dreadful catastrophe could overtake the long-suffering body of students whose interests are often lost sight of by teachers ambitious to become authors.

Although a very general practice, it is by no means always a sound one, to insist upon a class using the texts prepared by its instructor, and this is true even when that text is one of the very best of its class. American students are often greatly benefited by the use of English text-books, and there are many American books used with profit in English schools. By using a text prepared by one able scholar and sitting under the instruction of another the student is doubly benefited, and the harm which comes from a multiplicity of texts would be greatly lessened if every author were forbidden to use his own book. It is quite true that under such conditions there would be many books never used at all, but this would be one of the principal advantages of the scheme.

The above remarks, while suggested by, are not considered as specially applicable to, the list of new books on Physics which they follow, all of which, and many more, have issued from the press within a very few months. It may safely be asserted that no other science has grown and developed during the past ten or fifteen years as has this, and this growth is reflected in the very large number of text-books and treatises of all grades which have made their appearance during the last few years. They are easily divided into three classes: those that possess real merit and originality of treatment and which could not be spared without serious loss; those that are good, at least not bad, and whose existence is harmless; and those that, for various reasons, are undesirable and unwelcome, because unsound in either matter or method or both. In physics teaching and text-books, as in every other department of education, there appears the fad and the 'faddist.' In these days everybody is running after something *new*, not something good or useful. To achieve reputation in educational circles it seems only necessary to exploit a novelty, but fortunately in science teaching a considerable restriction is put upon this tendency by the inflexibility of natural laws. Curiously enough, in the making of books on physics that which is really most difficult is generally thought to be the easiest and is, therefore, the more frequently attempted. In the preparation of an extensive treatise on the subject the all important feature is matter, method being of only secondary importance; while in a text-book method of presentation rises to an importance fully equal to that of a truthful presentation of the principles and facts of the science, especially as it includes the selection of just what principles and what facts shall be set forth. Yet, although few undertake the preparation of a treatise, many esteem themselves fit to make a text-book. A well written treatise will usually include essentially all that the author knows about the subject; a well prepared text-book will generally represent only a small part of his knowledge.

Unfortunately too many text-books in physics contain all their authors know and much more, but the latter-day willingness of really able scholars to prepare elementary texts will before long put an end to their popularity.

The list of books given above contains several that will do to 'tie to.' The well-known text of Anthony and Brackett, published first about ten years ago, has enjoyed extensive and deserved approval as a college text-book of physics, and in this, the eighth edition, it has undergone extensive revision and improvement at the hands of Professor Magie, of Princeton, who had much to do with its making in the beginning. The changes are most evident in the treatment of electricity and magnetism and in the discussion of mechanics and the Kinetic theory of matter, in which respects as well as along some other lines the book has been practically re-written. The methods of treatment and the conception of fundamentals have been modernized, and the new edition constitutes a distinct advance, although the general features

of the original plan are preserved. The book constitutes an excellent college course on physics when supplemented, as it is meant to be, by full experimental illustrations on the lecture table. It is in no sense a laboratory guide, nor does it imply the existence or use of a laboratory.

For the great majority of students such a book and such a course ought to be supplemented by the use of a collection of problems illustrating the various divisions of the subject, and which are quite necessary to fix its principles.

The *Problems and Questions in Physics*, by Matthews and Shearer, will fairly well satisfy the demand for such a collection. The selection and arrangement of problems is, on the whole, very satisfactory, but the authors seem to have been continually in doubt as to whether they were not, after all, making a 'text-book.' Certain subjects are discussed at greater or less length, although the same matter will be found in almost any standard text. Considerable cost and space might have been saved by adhering strictly to the plan of a book of problems, and, indeed, some of the discussions do not tend to clarify the subject in any degree. No student can go through this book, however, without being greatly benefited.

Similar in grade to and not differing materially in plan from the new edition of Anthony and Brackett is the *Elements of Physics*, by Nichols and Franklin, the third and last volume of which has just been issued. Light and Sound are the subjects considered, and the treatment is largely mathematical yet elementary. There are no problems or exercises, and the scheme assumes lecture-table illustrations and occasional expansions by the instructor supplemented by actual laboratory practice by the student. Those who are familiar with the earlier volumes of this series will not need to be told that the work is well done and that the publication of this volume completes a valuable addition to the growing list of available text-books for use in colleges and in engineering or technical schools.

Professor Nichols also offers, in the *Outlines of Physics*, a text-book for the use of high schools or academies, a thorough knowledge of which he hopes may be accepted in lieu of a year of more advanced mathematics now required for admission to some colleges. There are some serious objections to this plan, to which extended consideration cannot be given in this place, for they in no way concern the character of the book under consideration. Every question concerning the relation of the secondary school to the college has two very distinct sides, but looking at only one of them, namely, the college side of the question, it may seem hardly wise to exchange a preparation in mathematics, which is undoubtedly more perfectly accomplished than anything else in secondary schools to-day, for a course in physics, instruction in which is far from what it should be. Professor Nichols's book contains a good résumé of the principles of the science, and is intended to serve at once as a text-book and laboratory guide. There is much difference of opinion among teachers of physics as to the wisdom of such a combination, many holding that really substantial results in the laboratory are only obtainable *after* a course in a good text-book with lecture-table illustrations, and that encouraging the average student to do laboratory exercises from the start is like plucking fruit before it is ripe. The immediate result is unsatisfactory, and subsequent perfection is well-nigh impossible. To those who believe in the method, however, Professor Nichols's book ought to take rank as one of the best of its kind, and, on account of its sound exposition of fundamental principles, much ahead of many that have appeared within the last decade.

Very similar in general character is the *Intermediate Course of Practical Physics*, by Schuster and Lees, which comes to us from the laboratory of Owens College, Manchester, to which physicists are already indebted for a number of high-class text-books. This book is extremely well done and will be of interest and value to all concerned with elementary instruction in physics. It is more nearly a laboratory guide than is Nichols's Outlines and should be used in connection with a text book. It may be criticised for the rather coarse experimentation which is occasionally employed. The standard of the laboratory should always be high, as the value of the work to the student depends almost entirely upon the degree of refinement and

precision required in its execution No laboratory in which such a book is likely to be used can fail to do better in the way of a simple pendulum than 'a string and a leaden bullet;' and successive values for 'g' ought not to differ from each other by as much as one and a-half per cent.

Professor Dolbear's little book on the *First Principles of Natural Philosophy* might impress one as being, in text as well as title, a protest against the progress of physics during the past quarter of a century. It is true that there are some things in it that were not known twenty-five years ago, but not many. Throughout the volume the author makes no mention of the metric units of mass and length, on the use of which so much of modern physics depends, declaring himself very decidedly against them in his preface. This naturally results in much confusion and difficulty, especially in the matter of electrical measurements. The fundamental principles of dynamics are presented in a confused and uncertain manner, and accuracy is sacrificed often apparently to secure simplicity.

Mr. Stone's *Experimental Physics* is evidently the outcome of his desire to satisfy the demands of the Harvard College entrance examinations in physics. The well-known 'forty experiments' prescribed by the Harvard authorities are included with a considerable number besides. The author says that the book is the result of nearly ten years' experience in teaching experimental physics, but he gives no hint as to how many years he has spent in studying the subject. The latter query is suggested by the numerous evidences of ignorance, or of extremely careless writing, which are scattered through the book.

Without raising the question of the soundness of the method adopted, which is that of laboratory work from the start, and before the student knows the simplest elements of his subject, it is sufficient to note that if the experiments outlined are made with care and reasonable precision very many of them will entirely disprove the principles they are intended to establish; while, on the other hand, if many of the principles laid down are accepted without careful tests the student will acquire many quite erroneous notions regarding the properties of matter and the principles of physical science. This is a serious indictment, but in its support it is only necessary to refer to the assumption that the breaking weights of wires of the same material are proportional to their cross sections; the announcement of the 'law' that for a given tension the elongation is inversely proportional to the area of the cross section of the wire, and other things similar in character. If the author had actually experimented on these things, instead of trying to tell others about them, he would not make such utterly absurd statements. The book contains many excellent problems, and now and then a good suggestion as to experimental methods.

There are many books of this type, and they all enjoy a common distinction of being, on the whole, more likely to create a distaste for real work than an appreciation of, and a love for, the science of physics. The study of the subject is made largely mechanical by having every experiment explained in the utmost detail, so that the student has nothing to do but to put the various pieces that he finds, carefully placed upon his desk, in the several relations explained in the book, and then note the result which the book tells him will follow. Occasionally some unfortunate may note that the prescribed result does *not* follow, but that something else happens, and in good time he may become a physicist, if not too thoroughly instructed.

It ought never to be lost sight of that the *real* value of instruction in physics, and especially in experimental physics, lies in *teaching people to think*. As a means of accomplishing this it has, perhaps, no rival, but both in and out of books the shadow is too often mistaken for the substance.

Antropologia della Stirpe Camitica. By Giuseppe Sergi. Torino, Fratelli Bocca. 1897. 8vo. Illustrated. Pp. 426.

This well-printed volume is part of an extensive study of the anthropology of Africa, projected by the distinguished professor of the University of Rome. It is devoted to the divisions, characteristics and distribution of that branch of the human species which, following

older authorities, he continues to call 'Hamitic.' To him this is more than a branch; it is a separate species of the genus *Homo*, to which, adopting the adjective first proposed by the writer of this notice, he assigns the term, 'Eurafrican,' indicating that its branches are to be found in both Europe and Africa (though he modifies the connotation of the term to suit his peculiar views).

Professor Sergi is best known from his physical studies of man, but in this volume he assigns linguistics a prominent place. In his preface, however, he is certainly unfair to his predecessors in asserting that they have not followed the zoological methods in anthropology. The very plan he puts forward as new, and his own, is perfectly familiar to readers of Darwin and Haeckel, and it can scarcely be ignorance of their anthropologic writings which led him to insert such a statement. His position as a polygenist is, moreover, surely inconsistent with the zoological method, as there is not a single zoologically specific difference to be found between the races of men. Therefore, what he calls in his preface 'the new and unexpected fact' of the specific independence of the Hamitic stock (for such it only is—not even with pure racial peculiarities) will be regarded as new, indeed, but far from true.

Nor will his treatment of the purely physical traits meet general acceptance. Skull forms have become less and less criteria of racial classification, and on these he bases most of his distinctions. The interesting and ethnically important question as to the origin of the blond Libyans he treats in a most unsatisfactory manner. Basing his opinion on a few local observations in Italy (themselves to be explained historically), he makes the extraordinary assertion that we may expect blonds above an altitude of 401 metres, and that the brown Lybians turned blonds by residing above that height! (p. 296.)

While the work is marred by these and some other grave deficiencies, its general composition is highly commendable. He divides the Hamitic stock, as others have done, into two branches, an eastern and a northern (others prefer western, which is more correct). The former are the 'black Hamites,' as the Somali and the Galla. He includes in them the ancient Egyptians, the Ethiopians and the Abyssinians, in which he will be followed but slowly, though no doubt they all partook of Hamitic blood at an early date. He also attaches to this branch the warlike Massai and the Wahuma. His northern branch embraces the Libyans and Berbers (who are, in fact, ethnically one), the tribes of the Sahara, the Tuaregs, Tebu and Fulbi, and the extinct Guanches of the Canary Islands. In these he does not go beyond the schemes of earlier writers.

In his concluding chapter he intimates the extension of his 'Eurafrican species' into Europe, concerning which he proposes to publish another volume. The 'species' will include the ancient peoples of Spain, Italy and Greece, Syria and central Europe, but will exclude the Celts, Slaves, Lithuanians and some Germanic peoples (p. 395). They belong to a different species! Certainly this is a strange use of a zoological term!

The work is well illustrated and contains a sketch map of the geographic position of the Hamites. There is also an excellent index.

To those readers who are acquainted with Professor Sergi's essay on 'the Mediterranean Stock' most of the theories in the work before us will be familiar. But the numerous facts which he has collected bearing on the traits and extension of the Hamitic stock will be gratefully received.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

Elementary Human Physiology. By J. G. M'KENDRICK, M.D., F.R.S. W. and R. Chambers, London and Edinburgh. 1896. Small 8vo. Pp. 240, with 164 woodcuts.

This book is based on a small manual on Animal Physiology, written by the author twenty years ago. The chapters are said to have been almost wholly rewritten and 'rearranged to suit the syllabus of the First or Elementary Stage, issued by the Department of Science and Art.' Copies of the examination papers of the Science department, South Kensington, for 1890–95 are given in an appendix.

As to the book itself, it may be said that the reviewer took it up with regret, recalling favorably a larger work by Professor M'Kendrick,

which appeared several years ago. The first impression was that this smaller volume was written around a set of illustrations of respectable age, but for the most part still serviceable. More careful reading, however, makes it clear that we are dealing with a pretty good elementary presentation of the subject, and that our first impression was not altogether just. We are ourselves somewhat skeptical of the scientific value of physiology in the secondary schools. Everything depends here upon the excellence of the teacher, and a good one will find M'Kendrick's book useful. It is to be sure, quite uneven, and in some places there is more detail than can be taken in by the class of students which the author seems elsewhere to have in mind. Much of the discussion is given with evident care and discrimination, and the facts presented are in general, despite the necessary brevity, quite fully modernized; even argon and the hot and cold spots are not forgotten, and the problems of interstitial secretion are suggested. There are, to be sure, many points on which one may well differ with the author, but most of them are perhaps not such as to involve serious defects. It must be said that the account of the nerve cells is altogether inadequate. The picture of them (Fig. 140) is quite in opposition to our present views and will make a stronger impression, we fear, than the explanation which partially corrects them and also shows that Professor M'Kendrick is well aware what the prevailing view is. The description of voice production is unsatisfactory and requires fuller illustrations without which most young students must find Fig. 164 hard to understand.

Joseph W. Warren.

Bryn Mawr College.

The Story of a Piece of Coal—What it is, whence it comes and whither it goes. By Edward A. Martin, F.G.S. New York, D. Appleton & Co. With thirty-eight illustrations. 16mo. Pp. 168.

Mr. Martin's little book shows that the author has read widely, has selected judiciously and has told the story pleasantly. The narration is attractive, and is likely to be commended by the readers for whom it is intended.

All this makes one regret that the judicious selection was not associated with accurate reading. There are serious slips in too many places, and there is too much of positive assertion where modest suggestion would be preferable. As for some of his statements, it must be said that he should have every opportunity to prove them, since many persons would not accept them without hesitation.

Among other things, he tells us that iron, silver and water alone possess the power of expanding, when passing from the liquid to the solid state (p. 80); that no explosions in the anthracite region of Pennsylvania were due to coal dust (p. 100); that coke if properly made, should consist of pure carbon, and that good coal should yield as much as 80 per cent. of coke in the gas retort (p. 109); that our anthracite is inexhaustible, and that the 'mammoth vein' extends for 650 miles along the west bank of the Susquehanna (p. 147).

Mr. Martin says (p. 152) that Britain will feel, with tremendous effect, the blow to her prestige when the first vessel laden with coal weighs anchor in a British harbor. Three such blows were administered in 1896 by one Kentucky concern, and the attack has been continued this year by another.

J. J. Stevenson.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 276TH MEETING, SATURDAY, APRIL 24.

Mr. M. A. Carleton spoke on 'Climate as an Element in Wheat Environment,' his remarks being mainly a comparison of the conditions prevailing in the wheat belt of southern Russia with those found in the western United States. He stated that low temperature, accompanied by aridity, prevented the raising of spring wheat, and that the successful ripening of grain did not depend on the average temperature, but on the total temperature of the hottest months. Mr. Frederick V. Coville presented a paper on the 'Plantfood of the Wild Ducks in Chesapeake Bay,' and particularly of the canvas back and its favorite food of the tubers of the wild celery. A large portion of the best feeding ground of the upper Chesapeake was de-

stroyed a few seasons ago by a combination of strong winds and heavy snowfall, followed by cold, the result being that exceptionally low water was produced, ice formed on the exposed flats, and when the tide finally came in the plants were torn away and carried off. Mr. Coville noted the conditions under which the shallow water could be restocked with the wild celery, and stated that it had been successfully transplanted to Western lakes, with the desired result of causing the canvas backs to linger there on their migrations.

Mr. Coville also described 'The Water Hyacinth, *Piaropus crassipes*, as an obstruction to navigation in Florida,' saying that in some of the shallow rivers the accumulation of the plants impeded the progress of the steamers. He showed a view of steamers so surrounded by the water hyacinth that they appeared to be lying in a meadow, and described the experiments made with a view to the possibility of destroying the plants.

Mr. Lyster H. Dewey described 'The Eastern Migration of Certain Weeds in America,' saying that the general trend of weed migration in the States east of the Rocky mountains, except in New England, has been westward, corresponding with the direction of the progress of cultivation and the movement of the supply of field seeds. In New England weeds have spread to the eastward, as illustrated by the Canada Thistle, *Carduus arvensis*, and the Orange hawkweed, *Hieracium aurantiacum*, introduced into Vermont and New York, and spreading from these States eastward. Yellow daisy, *Rudbeckia hirta;* bracted plantain, *Plantago aristata;* low amaranth, *Amaranthus blitoides;* marsh elder, *Iva xanthifolia;* buffalo bur, *Solanum rostratum;* squirrel tail, *Hordeum jubatum*, and Russian Thistle, *Salsola kali tragus*, are given as instances of weeds that have spread to the eastward. While the westward migration of weeds has been largely through impure field seeds, the eastward movement appears to be chiefly along railroads, in baled hay, grain and wool.

277TH MEETING, SATURDAY, MAY 8.

THE entire evening was devoted to the presentation and discussion of a paper by Dr. C. Hart Merriam, on 'Suggestions for a New Method of Weighing Species and Subspecies,' which appeared in the last issue of SCIENCE.

F. A. LUCAS,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the regular meeting of April 14, 1897, Mr. H. W. Turner read a paper on 'A new Amphibole-pyroxene rock and some Orbicular rocks from California.'

The new amphibole-pyroxene rocks consists of original augite and amphibole in grains, of nearly equal size, with a little quartz and some pyrrhotite. The rock contains numerous phenocrysts of brown amphibole, which contain in a poikilitic manner the constituents of the ground mass. This rock is one type of a very interesting series of basic igneous rocks found in the foot hills of Mariposa county, California.

Some orbicular rocks were exhibited, as well as an inclusion in granite, around which an aureole, composed of amphibole, had formed. The material of this aureole appears to have been segregated from the granite. Two specimens of dikes were exhibited, the center of each of which contained more silica than the borders. Reference was also made to dikes in the rainy lake region, shown by Lawson to have an interior portion more siliceous than the borders. It is well known, as a general rule, that the less siliceous elements crystallize out first in all rock magmas. The walls of the dike being cooler, the less siliceous minerals would crystallize out first along the border, and the more acid minerals be transferred by convection currents, or in part crowded out by the already crystallized material toward the interior. It is evident that along the borders of an intrusive area of great size the same phenomenon might be shown. We should simply have the case of one side of the dike. The laws of thermochemistry would appear to be applicable to this case, inasmuch as the heat generated by the crystallization of the minerals might aid in establishing convection currents to transport the residual siliceous constituents away from the already consolidated material.

Under the title 'Laccoliths in Folded Strata,' Mr. W. H. Weed described the occurrence of a number of lenticular masses of intrusive rock

in the axes of folds, in the mountain groups of the plains of Montana, and one of the front ranges of the Rocky Mountains. In applying the term laccolith to such masses there is a wide departure from the original use of the word. It is therefore used provisionally, the right being reserved to designate such concavo-convex lenticular masses by an appropriate name at a future time.

The presence of such intrusions is believed to be due to causes in marked contrast to those of laccoliths. On the normal laccolith the intrusion causes the arching of previously horizontal strata. In the masses described the intrusion follows or accompanies the folding and is dependent upon it; that folding is the cause and not the result of igneous intrusion. The author offers a theory to explain the intrusion of such masses, utilizing the discussion of folds by Willis and by Van Hise to show that intrusion from below would be most easy at the hinge of such uplifts or the arch of synclines, and that such intrusion could not penetrate far, owing to compression near the concave surface of arches, so that further intrusion would be along a strata or other bed of easy parting toward the center of the fold when the presence of an arch due to a competent strata of limestone would leave a space beneath of little compression and consequent easy filling by the liquid magma.

W. F. Morsell.

U. S. Geological Survey.

SCIENCE CLUB OF NORTHWESTERN UNIVERSITY.

At a meeting of the Science Club of Northwestern University, held on Friday evening, May 7th, inst., a paper was read by Miss Mary E. Gloss on the 'Mesophyll of Ferns.' The theory of the formation of the palisade tissue in intense sunlight does not seem to apply in the case of ferns. All the species examined were grown in diffused light, with one exception; some have palisade parenchyma and some have not; the presence or absence of the palisade parenchyma was nearly constant throughout each of the genera examined, which may prove to be a generic characteristic. The presence or absence of chlorophyll in tbe epidermis, the form and arrangement of the cells of the mesophyll, the size of the air spaces and the thickness of the mesophyll appear to be nearly constant in each of the genera examined. The genera most carefully examined were *Adiantum*, *Aspidium*, *Nephrolepis* and *Polypodium*. The investigation will be continued until a large number of genera has been covered.

Thomas F. Holgate,
Secretary.

THE TEXAS ACADEMY OF SCIENCE.

At the May meeting of the Texas Academy of Science, held on the evening of the 7th inst., the following papers were presented:

'The Properties of the Living Substance,' by Dr. Edmund Montgomery, of Hemstead, Texas.

'An Account of some Applications of the Bessel Functions to Astronomy,' by Harry Y. Benedict, of Cambridge, Mass.

'A Note on a Generalization of the Numbers of Couchy,' also by Mr. Benedict.

'Triazines and Triazoles,' by James R. Bailey and S. F. Acree.

'On the Constitution of a By-product obtained in the Preparation of Hydrazopropionic Acid,' by James R. Bailey and Henry B. Dechard.

The last named papers embody the results of some original work performed in the chemical laboratory of the State University, under the direction of Mr. Bailey, the senior author.

Major Dutton's address on the 'The Economics of Concentrated Capital,' and Professor Nagle's paper on 'Vertical Curves for Railways,' now in press, will be ready for distribution in a few days.

Frederic W. Simonds.

University of Texas.

NEW BOOKS.

Grundriss der Entwicklungsgeschichte der Menschen und der Säugetheere. Oscar Schultze. Zweite Hälfte. Leipzig, Engelmann. 1897. Pp. vii+468. M. 6.

Dynamic Sociology. Lester F. Ward. New York, D. Appleton & Co. 2d Ed. 1897. Vol. I., pp. xl+706. Vol. II., pp. vii+690.

Bird Life. Frank M. Chapman. New York, D. Appleton & Co. 1897. Pp. xii+269. $1.75.

Antiquities of Tennessee. Gates P. Thruston. Cincinnati, The Robert Clarke Co. 1897. Pp. xv+369.